

International Marine Engineering

OCTOBER, 1912



City of Detroit III; World's Largest Side Wheel Steamer

The latest addition to the magnificent fleet of the Detroit & Cleveland Navigation Company is the *City of Detroit III*, a vessel which is not only the largest side-wheel steamer in the world but also the most superbly finished craft of this type. The ship was built at the Wyandotte yards of the Detroit Shipbuilding Company according to designs from Mr. Frank E. Kirby, who also supervised its construction. The vessel was launched Oct. 7, 1911, and her trial runs were made

PROPELLING MACHINERY

The main engine is of the inclined three-cylinder, compound, jet condensing type, having one high-pressure and two low-pressure cylinders. The estimated indicated horsepower is 8,000 at 30 revolutions per minute. The high-pressure cylinder is 62 inches in diameter, weighs 47,200 pounds, and is placed between the two low-pressure cylinders, which are 92 inches in diameter, all having a piston stroke of 102 inches.

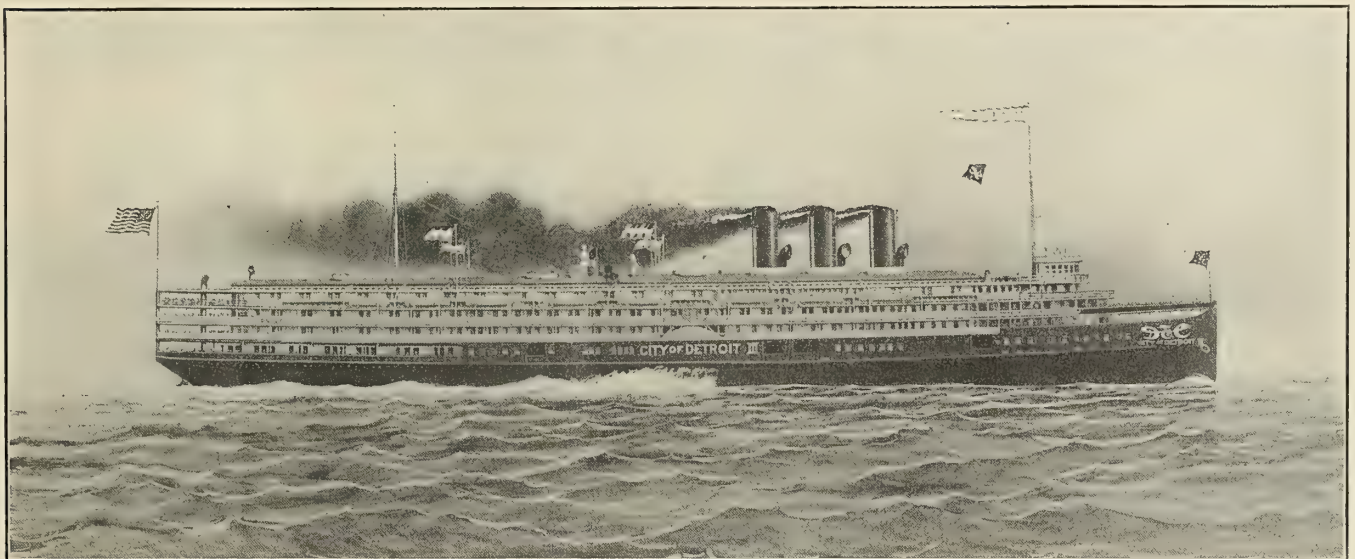


FIG. 1.—SIDE-WHEEL LAKE STEAMER CITY OF DETROIT III

early in June of this year. The principal dimensions of the ship are:

Length over all.....	470 feet.
Length on keel.....	455 feet.
Beam, molded.....	55 feet 4 inches.
Beam, over guards.....	96 feet 6 inches.
Depth at stem.....	22 feet.
Depth at stern.....	29 feet 3 inches.
Depth at guards.....	21 feet 3 inches.

The hull is built of steel with a double bottom, and is divided into eleven compartments by watertight transverse bulkheads extending from the keel to the main deck. The double bottom is divided at the center line and athwartships into fifteen watertight tanks. There are two decks below the main deck and three above. The main deck and housings on the main deck and orlop deck are also of steel. A steel superstructure is carried to the main deck, though the ceiling of the saloon deck is sheathed with galvanized iron, practically making her entire housing up to the saloon deck fireproof. A steadying tank of 100 tons capacity is provided amidships to check rolling in a heavy sea.

None of the cylinders is steam jacketed, but together with the two large tank receivers they are well insulated.

The high-pressure cylinder is fitted with poppet valves and Seckles cut-off gear, while the low-pressure cylinders have Corliss valves and gear. All the valves are operated by ordinary double-bar Stephenson link motion, and the cut-off in each cylinder has a range of from one-fourth to three-fourths of the stroke, adjustable from the starting platform.

The pistons are of cast steel, conical, and of single thickness, and are fitted with cast iron spring and junk rings. The piston rods, crossheads, connecting rods, guide struts and crankshaft are all of the highest quality of steel forgings supplied by the Midvale Steel Company.

The crankshaft is 25 inches in diameter in the engine bearings, and 27½ inches in diameter at the outer bearings and 71½ feet long from end to end, and weighs 103½ tons. It is made in three sections, connected by flanged couplings, which are recessed into the hubs of the crank arms. The crank arms are sunk into the pins, thus making the crankshaft perfectly rigid from end to end and avoiding all the trouble incidental to loose pins, wedges, etc. The crank shafting and pins are hollow throughout.

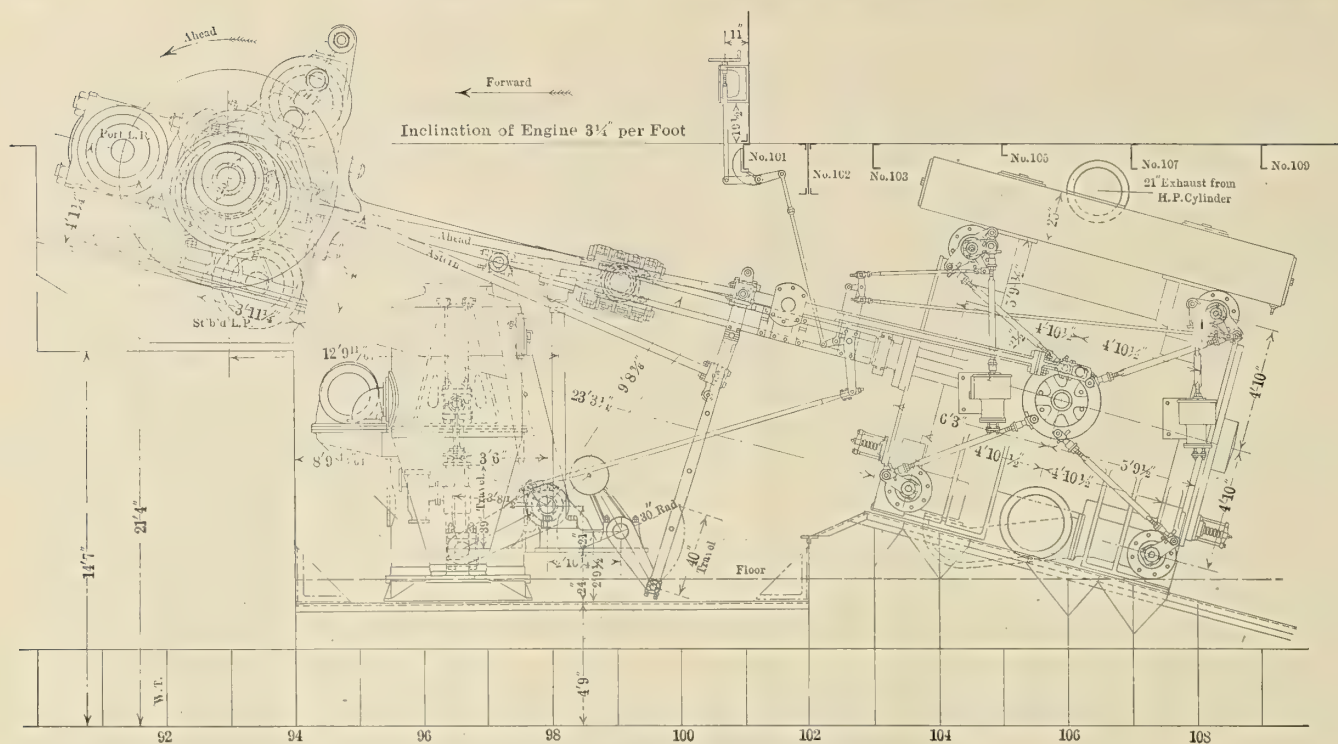


FIG. 2.—COMPOUND INCLINED ENGINE OF CITY OF DETROIT III

The connecting rods are 20 feet center to center and $13\frac{1}{2}$ inches diameter at the center of their length. The crank pin end is fitted with round brasses lined with white metal, the caps being forged steel worked out of the main forgings. The crosshead end is forked and fitted with flat-bottomed brasses and wrought steel caps and bolts. Each connecting rod weighs approximately 10 tons. The piston rods are 12 inches in

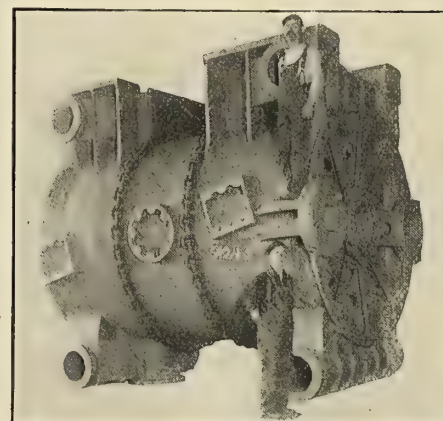
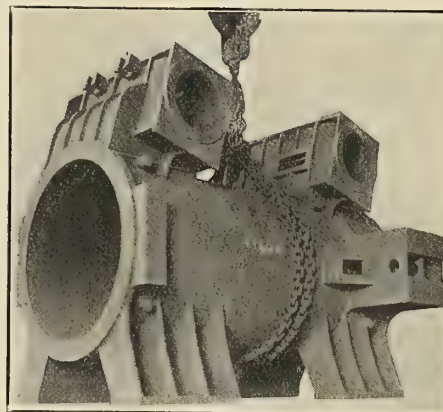


FIG. 4.—HIGH AND LOW PRESSURE CYLINDERS

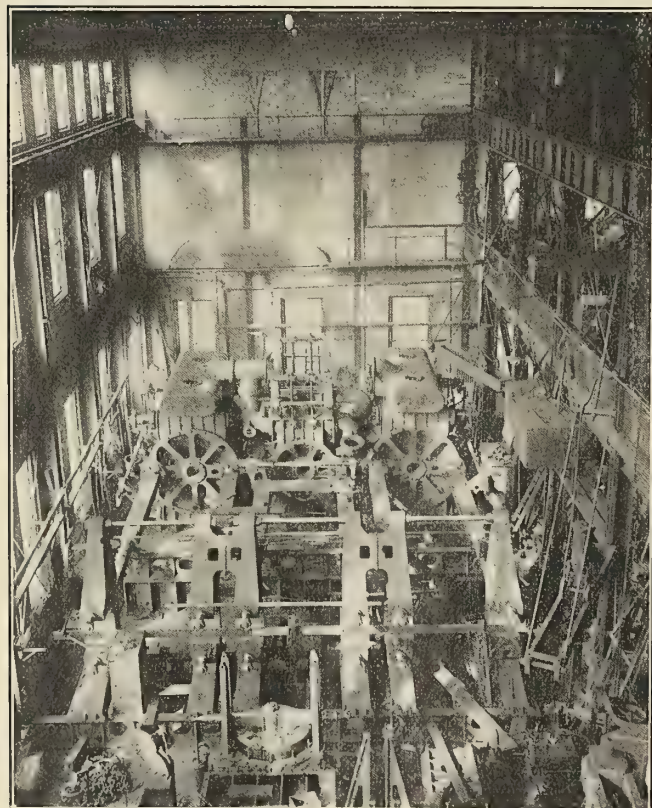


FIG. 3.—ENGINE ON ERECTION FLOOR OF BUILDER'S WORKS

diameter, and the crosshead slippers are steel castings faced with white metal.

The main bearing pedestals, six in number, are massive steel castings rigidly bolted to the foundations, which are part of the ship structure, and braced together to insure stiffness when the engine is working. The caps are steel castings, box sections, the bearings being circular shells lined with white

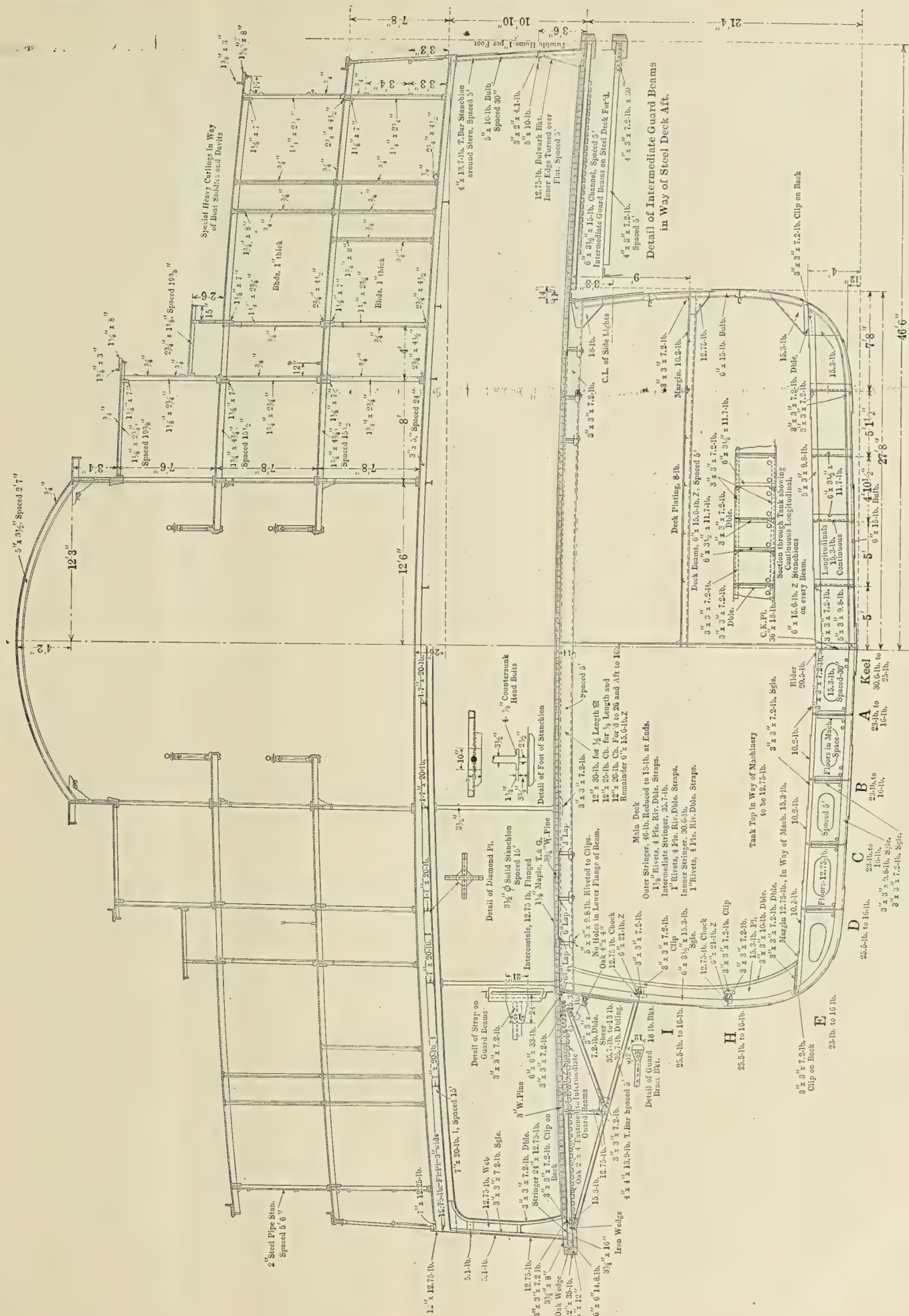
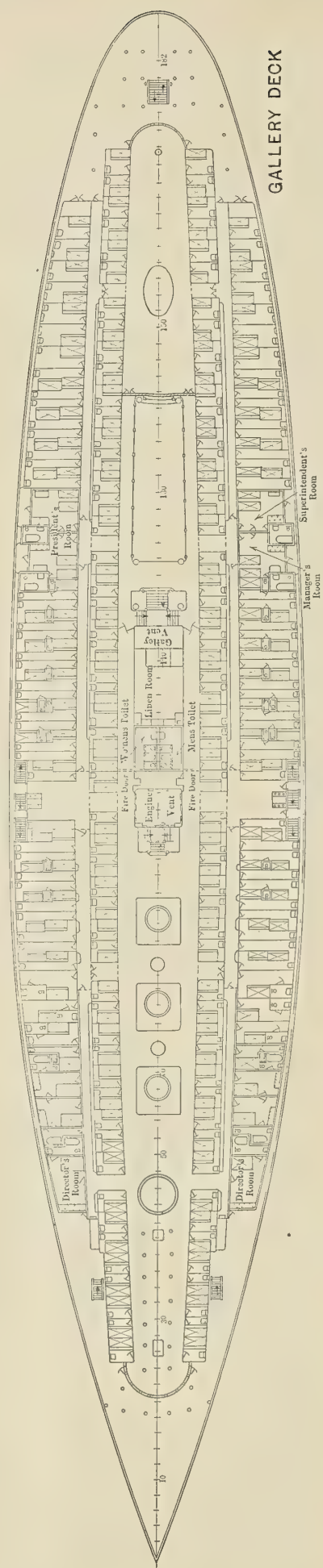
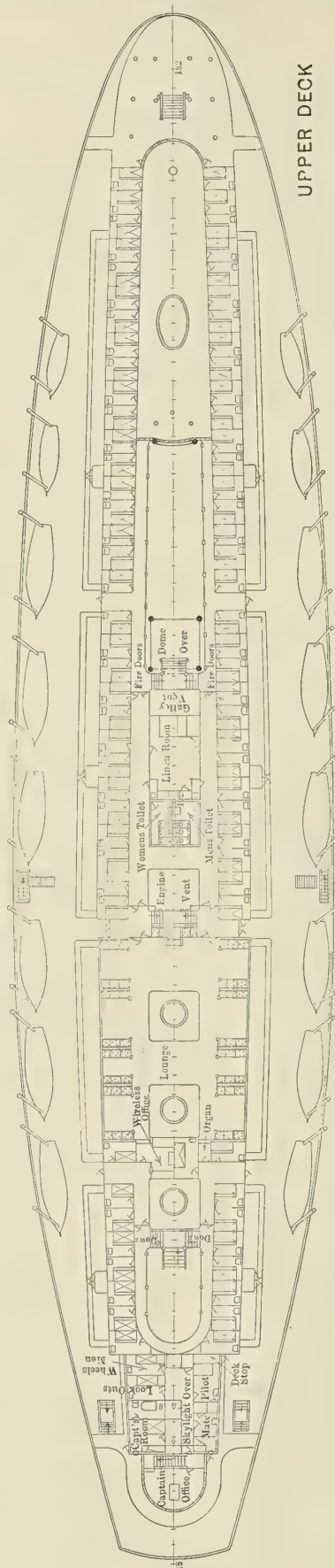
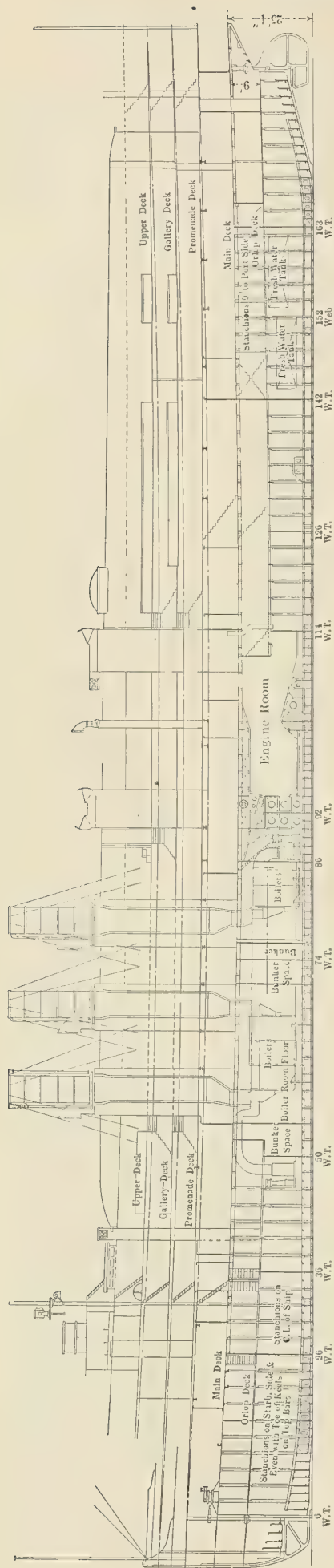


FIG. 5.—MIDSHIP SECTION OF CITY OF DETROIT III



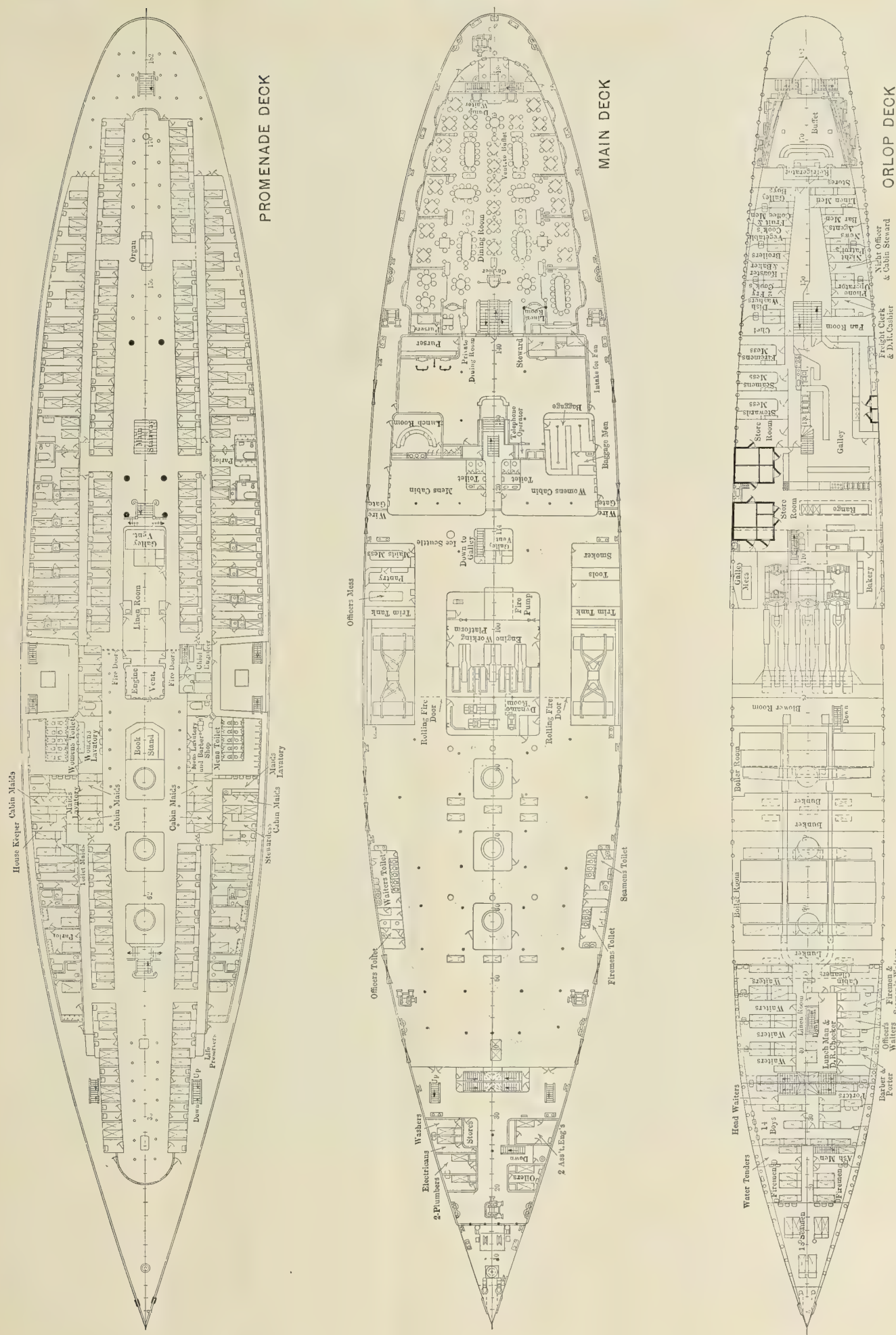


FIG. 6.—INBOARD PROFILE AND DECK PLANS OF CITY OF DETROIT III

metal. The guide struts are connected to the main bearing castings by a T-end, through which the main bearing bolts are extended and to the cylinder by round flanges and bolts. Midway in their length they are supported by vertical columns carried from the ship's floors.

Each cylinder is cast complete with its valve chests, thus avoiding all unnecessary and oftentimes troublesome joints.

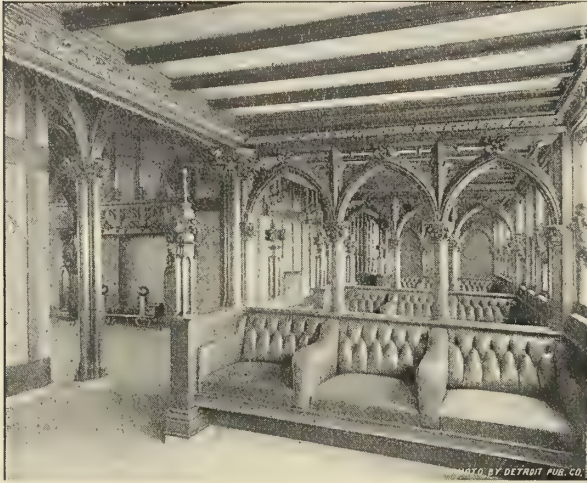


FIG. 7.—GOTHIC ROOM WITH FIRE PLACE (COPYRIGHT, DETROIT PUB. CO.)

The front heads are also cast with the cylinders, and are strongly ribbed to distribute the strain from the guide struts. The finished low-pressure cylinders weigh approximately 27¾ tons each, and are excellent specimens of the founder's art.

The main air pumps, two in number, are of the vertical, single-acting plunger and bucket type, driven through heavy forged steel bell crank levers from the low-pressure cross-heads. Each air pump cross-head also carries the plunger of a single-acting vertical feed and bilge pump.

The condensers are built up of riveted plate, and each low-pressure cylinder connects with its own condenser through a 24-inch exhaust pipe. The reversing of the engines is accomplished by means of a direct-acting steam gear, but a powerful

anced type, operated by a simple lever, and is fitted with an 8-inch "by-pass" or maneuvering valve, which is sufficiently large to operate the engine up to half speed.

The lubricating system is elaborate and complete, as are the appliances to assist in the overhauling or lifting of the engine parts.

The paddle-wheels are unusually strong and heavy, and are



FIG. 9.—MAIN STAIRWAY

designed to successfully meet the severe ice conditions met with in the early part of the season. The centers are of cast steel and the arms of forged iron, with the large gudgeon bosses forged on and bushed with lignum vitæ. The wheels are 30 feet 3 inches outside diameter, each fitted with eleven curved steel buckets, 14 feet 6 inches long by 5 feet wide, and on the outer ends are supported by a 14-ton steel truss. The radius rods are of steel fitted with brass bushings. The out-board bearings are heavy steel castings lined with white metal, and are adjustable in vertical and fore and aft directions.

BOILERS

Steam at 160 pounds per square inch pressure is supplied by



FIG. 8.—DINING ROOM ON MAIN DECK



FIG. 10.—PALM COURT WITH FOUNTAIN

hand-operated worm reversing gear is fitted for emergency use.

The handling gear levers are all conveniently grouped in a quadrant on the working platform above the cylinders, and, massive though the moving parts are, the reversing, etc., is accomplished with great ease and facility. The main throttle valve, 17 inches in diameter, is of the Schuette-Körting bal-

six cylindrical return tube boilers of the following dimensions: One single-ended 13 feet 9 inches diameter by 12 feet long with two 52 inches diameter Morison furnaces; one double-ended 13 feet 9 inches diameter by 22 feet long with four 52 inches diameter Morison furnaces; two single-ended 14 feet 8 inches diameter by 12 feet long with three 44 inches diameter Morison furnaces; two double-ended 14 feet 8 inches

diameter by 22 feet long with six 44 inches diameter Morison furnaces, making six 52 inches diameter and 18, 44 inches diameter furnaces, or 24 in all. The grates are all 5 feet 6 inches long.

The boilers are placed in two batteries of three each, and are fired in a fore-and-aft direction, the coal being carried in three athwartship bunkers. The Howden system of heated air forced draft is fitted, the air being supplied by three Sirocco fans direct driven by vertical American Blower Company engines. There are three funnels, with outer casings fitted up to the level of the top deck and single above.

The ashes are discharged overboard and well clear of the ship by means of six double jet ash ejectors, two in each stokehold. The stokeholds are well ventilated, and are remarkably cool even when the vessel is steaming at full power.

AUXILIARY MACHINERY

The electrical equipment consists of two 75-kilowatt Kerr turbine-driven Northern generators, working at 1,800 revolu-



FIG. 11.—GRAND SALOON (COPYRIGHT, DETROIT PUB. CO.)

tions per minute, 110 to 120 volts, and also one 35-kilowatt machine of the same make working at 3,600 revolutions. The two 75-kilowatt machines exhaust into a Dean jet condenser, with 10-inch by 18-inch by 18-inch air pump. There is a Blake vertical duplex compound ballast pump, 15 inches by 24 inches by 18 inches, pumping from the water bottom and discharging overboard or to the trimming tanks at will. The sanitary pump is also a Blake duplex compound, 8 inches by 14 inches by 12 inches, supplying water to the toilet rooms, also cooling water for the main engine. The fresh-water pump is a Blake duplex, 8 inches by 10 inches by 12 inches, drawing water for four fresh-water tanks of a combined capacity of 17,000 gallons. The water for drinking purposes is all purified by an electrical apparatus furnished by the Water Purifying Machine Company, of Buffalo, N. Y. In addition to the sprinkling pump for fire purposes there is also a Blake underwriters' pump, 16 inches by 9 inches by 12 inches, also an auxiliary feed pump, Blake duplex, 14 inches by 7½ inches by 12 inches.

PASSENGER ACCOMMODATIONS

The lobby on the main deck is of the Doric order of architecture, finished in bold figured selected mahogany inlaid with marquetry with scagliola columns, having carved capitals with brass bases. The ceiling panels are in composition relief finished in gold. The ceiling and wall fixtures are finished in burnished antique gold, the windows and doors glazed with plate and opalescent glass and the floor of interlocking rubber tiling.

The main dining room, aft of the lobby, is of imposing size.

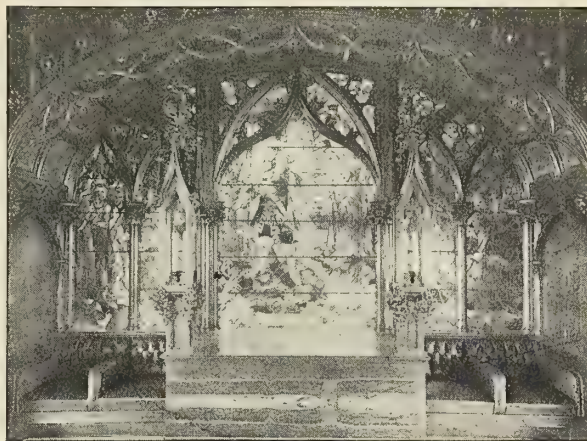


FIG. 12.—LA SALLE WINDOW IN GOTHIC ROOM (COPYRIGHT, DETROIT PUB. CO.)

It is 90 feet long and 60 feet wide, affording accommodations for 350 passengers. The broad bay windows on either side afford a superb outlook over the water as the steamer speeds on her way. The simple yet harmonious decorations are of the Colonial style, the walls being wainscoted in old mahogany, 3 feet 6 inches high, with paneling above in old ivory adorned with exquisite carving in low relief on a golden yellow ground. The ceiling, which is supported by richly carved pilasters and columns, is paneled and decorated in harmonious colors. On the floor is spread a fine Wilton carpet in shades of green and old gold, while the furniture is executed in solid old mahogany of Colonial design. The 400 electric lamps are executed in old silver of Sheffield finish, and shine on spotless



FIG. 13.—PARLOR WITH PRIVATE VERANDA

table linen, delicate china, beautiful cut glass, and polished silver, completing a most artistic creation.

In the buffet, directly beneath the dining room, the ceiling, of groined Romanesque arches, is supported by massive columns, but the chief decorative feature is the wine casks of German manufacture beautifully carved. The floor is of Pewabic tile, and all-woodwork is of white oak, including the furnishings. Other striking features of the room are paneled hogsheads with iron bands above the settees on either side of the room, the heads of the hogsheads being decorated with

burnt work in colors. The electrical fixtures are in the form of old hammered brass lanterns.

From the lobby the main stairway leads to the grand saloon on the promenade deck. It is designed in the Corinthian style; the main ceiling, with its massive and elaborately carved frames, with medallions and ornaments, being a masterpiece of carving and sculpture. Beautiful mural paintings, with the soft light properly illuminating, adorn the ceiling, and represent "Diana riding her golden chariot drawn by doves," "Nymphs playing in trees," and other mythological subjects. Directly above the grand stairway, and leading to the gallery and upper decks, is a spacious dome, rising to the upper deck house, which is supported by massive Corinthian columns and carved capitals. The dome has lunette panels with mural paintings surrounded by richly carved frames. The color scheme of the grand saloon is blended in gray ivory, pearl gray and white, and lightly embellished with Roman gold; the carpets throughout the main saloon are of the best Wilton, in shades of green for the promenade deck to harmonize with the mahogany woodwork and furnishings. On the gallery deck the carpets are in the shades of old rose in harmony with the gray tones of the decorations. The carved furniture, in Roman gold, is in exact keeping with the surroundings.

Aft of the main saloon and on the gallery deck is a sumptuous drawing room designed in the Marie Antoinette style. Here the walls and ceilings are paneled and finished in gray ivory enamel, with decorations in exquisite carving in low relief. The color scheme is gray and Cerulean blue, in exact shade to which the carpets and draperies are in perfect harmony. The furniture is carved in Italian walnut with Roman gold mounts; the upholstery is in velvet with a diminutive pattern, while the lighting fixtures consist of carved standards in Roman gold with silk shades.

A unique palm court on the upper deck directly above the drawing room forms a most pleasant place to linger and chat. It is finished in pure white with trellis panels and pilasters. There are beautifully carved flower stands filled with natural vines and flowers, a charming fountain from which water will play in a marble basin. In the center of the room is a Pergola decorated with trellis and natural vines supported by carved fauns and columns. The lighting is from concealed lamps in the cornice, and illuminates the bright Mediterranean sky partly concealed by natural vines.

The Gothic room, on the upper deck, is finished in old English Gothic, displaying the quiet grandeur of the interior of an old chapel or of an old European mansion. The woodwork is of elaborately carved English oak, embellished in strong colors and gold and finished in antique style. Large columns, supporting richly carved arches and spandrels, separate and divide this room into cozy recesses. Soft upholstered settees are built into these spaces, and so arranged with chairs to form convenient groups for parties. In the center of the room and between the stacks is a nook with a cheerful fireplace to add to the pervading effect of comfort. At the forward end is a large pipe organ, built in place, which fills the room with melodious music. At the after end is a beautifully stained glass window, being an allegorical representation of the early days of Detroit.

A modern ventilating system renews the air supply in all parts of the ship where such artificial circulation is required. With this system inside rooms are continually supplied with washed fresh air, making them as comfortable and desirable as outside rooms.

There are 600 staterooms, 25 parlors with bath, and 50 semi-parlors with private toilets. All the staterooms and parlors are supplied with hot and cold running water and telephones.

SAFETY APPLIANCES

All of the latest approved types of mechanical equipment for the safety of the ship have been installed. There is a Marconi

wireless system which places the vessel in communication with the shore and other vessels at all times while under way. Lifeboats and liferafts sufficient for all the passengers have been provided. A special feature is the installation of an automatic sprinkling system for protection against fire. There is an automatic fire alarm, which reaches all parts of the ship. It consists of an automatic thermostat which contains a small hollow copper wire which is connected to a sensitive diaphragm or plate, the latter sounding the alarm. The wire is installed in staterooms and other sections of the boat in such a manner that it is exposed so that a certain degree of heat causes it at once to sound the alarm signal. The wire is so small that it can be placed over moldings and around fancy scroll work, such as form part of the decorations in the staterooms and public rooms. The entire boat is divided into sections, eight staterooms to a section, and when an alarm is sounded in any part of the ship an indicator or annunciator shows in just what section of the boat the fire has started. The wire is sensitive only to heat, registering 140 degrees F. or more, a limit, however, which makes it susceptible to the heat of a burning newspaper if held near it. There are also fire walls of asbestos and galvanized iron lining, which divide the ship adequately for fire protection.

TRIAL TRIP

The owner's trial trip of the *City of Detroit III*, took place on June 8. A run was made from Southeast Shoal to Long Point in Lake Erie, a distance of 133¼ miles. The time for the run was 6 hours 20 minutes, making an average speed of 21.05 miles per hour. The average horsepower developed was 7,606. No data were taken as to maximum speed, but during the trip one of the safety valves blew off at 140 pounds, and it is considered that the vessel is capable of a considerably better speed than 21 miles an hour when operated under a full head of steam. On the return trip from Long Point to Southeast Shoal the vessel was steered with the Akers auxiliary steam steering gear, the shift from the regular gear being made in four seconds.

Swan, Hunter & Wigham Richardsons, Ltd., of Wallsend-on-Tyne, has under construction for the Montreal Transportation Company for service on the Canadian canals and lakes a Diesel-engined ship having a deadweight carrying capacity of 2,400 gross tons on a draft of 14 feet, which will be equipped with electrical transmission. There are two sets of Diesel engines of 300 horsepower each, running at 400 revolutions per minute. Each engine is direct connected to an alternating-current generator, which supplies current for a compound-wound squirrel-cage induction motor coupled to the propeller shaft, which will turn the propeller at 80 revolutions per minute. This machinery arrangement is according to designs by H. A. Mavor, of Mavor & Coulson, Ltd., Glasgow.

The Diesel-engined Standard Oil barge No. 62, described in our March issue, recently made a trip of about 175 miles from New York to Providence, R. I., in a little over eleven hours. The barge was heavily loaded, but the amount of fuel oil consumed was only about 300 gallons, the price per gallon at that time being 4 cents (2d.). After discharging cargo in Providence the barge left in light condition for New York. The run on the return trip was under bad weather conditions, causing the propeller to be lifted out of the water frequently. Under such conditions, however, it was reported that the governing device worked very satisfactorily, and at no time did the propeller make more than 350 revolutions per minute.

United States Battleships Wyoming and Arkansas

BY HENDERSON B. GREGORY

Battleships Nos. 32 and 33, the *Wyoming* and *Arkansas*, are the two sister ships authorized by an act of Congress approved March 3, 1909. They are four-screw Parsons turbine vessels, designed for a speed of 20.5 knots, at 26,000 tons displacement and with the main engines developing 28,000 shaft-horsepower. The former was built by the William Cramp & Sons Ship & Engine Building Company, of Philadelphia, Pa., and the later by the New York Shipbuilding Company, of Camden, N. J. The contracts were signed Oct. 14 and Sept. 25, 1909, respectively, the prices being \$4,450,000 (£914,000) and \$4,675,000 (£960,000).

extending from stem to turret No. 3, on which are the junior officers' quarters. (6) Berth or protective deck, containing storerooms forward, coal bunkers amidships, crew's space, refrigerating plant and workshop aft. (7) Upper platform equipped with storerooms, chain lockers, windlass machinery, magazines, handling rooms, central station, coal bunkers, etc. (8) Lower platforms, where are located stores, torpedo room, magazines, handling rooms, dynamo rooms, steering gear and coal bunkers.

Hold—In the hold are trimming tanks forward and aft, stores, engine and boiler rooms and coal bunkers.

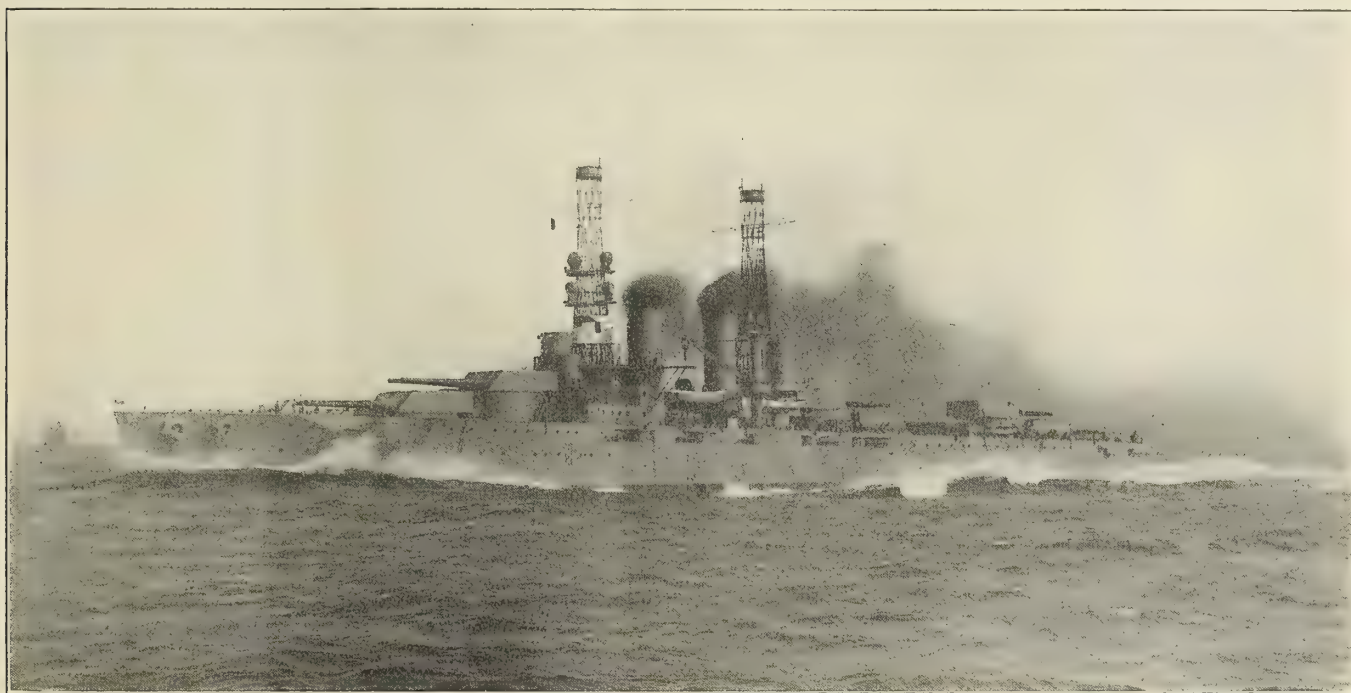


FIG. 1.—BATTLESHIP WYOMING ON FULL SPEED TRIAL

(PHOTOGRAPH BY N. L. STEBBINS)

PRINCIPAL HULL DIMENSIONS

Length on L. W. L., feet and inches.....	554 0
Length overall, feet and inches.....	562 0
Breadth, extreme, at L. W. L., feet and inches.....	93 2½
Draft to L. W. L., feet and inches.....	28 6
Displacement corresponding, tons.....	26,000
Ratio of length to beam.....	5.943

BRIDGES, DECKS, ETC.

Masts—There are two masts of the cage type, located on the center line of the vessel, one forward and the other aft of the smokestacks. The masts are equipped with searchlight platforms, wireless telegraphy outfit, signal yards, etc.

Bridges—There are two bridges—a flying bridge and bridge—the steering platform being at the elevation of the former.

Decks—The vessel has eight decks, as follows: (1) Bridge deck, on which is located the chart house. (2) Superstructure deck, containing the captain's, executive officer's and navigator's quarters. (3) Main deck, which is exclusively a weather deck except for the deck houses amidships, in which are located the galleys, blacksmith shop and foundry, and the admiral's and staff officers' quarters in the deck house forward; the main battery is also on this deck. (4) Gun deck, where are located the 5-inch battery, wardroom quarters forward, warrant officers' quarters, petty officers' and crew's quarters, sick bay, laundry and offices aft. (5) Half-deck,

Double Bottoms—The usual double bottom compartments are provided. Those under the forward fire-rooms are fitted for reserve feed tanks and those amidships, between the engine and fire-room space, are provided for fuel oil.

BATTERY

The main battery of twelve 12-inch guns is located on the main deck. The guns are arranged in pairs in six turrets on the center line of the vessel. Turrets Nos. 1 and 2 can train on either broadside and dead ahead, the latter being elevated so as to fire ahead over the top of the former. The other turrets are grouped in pairs aft, Nos. 3 and 4 being just forward of and Nos. 5 and 6 abaft the engine hatches. In each case the forward turret is elevated, permitting direct astern fire for turret No. 5 over the top of No. 6, and allowing No. 3 turret to train on either broadside and well aft.

A secondary battery of twenty-one 5-inch rapid-fire guns for torpedo defense is also provided, together with the following smaller guns:

- Four 3-pounder saluting guns.
- Two 1-pounder guns for boats.
- Two 0.30-inch machine guns.
- Two 3-inch field pieces.

There are also two 21-inch submarine torpedo tubes.

BOATS CARRIED

The following boats are carried on the main deck and in skid deck beams at the superstructure deck level:

- Two 50-foot steam cutters.
- One 40-foot steam cutter.
- One 40-foot gasoline (petrol) motor barge for the admiral.
- Two 40-foot motor sailing launches.
- Two 36-foot sailing launches.
- One 31-foot racing cutter.
- Two 30-foot cutters.
- Two 30-foot whale boats.
- Two 24-foot dinghies.
- Two 14-foot punts.

Two electrically-operated boat cranes are provided for handling all boats except the whale boats, which are hung

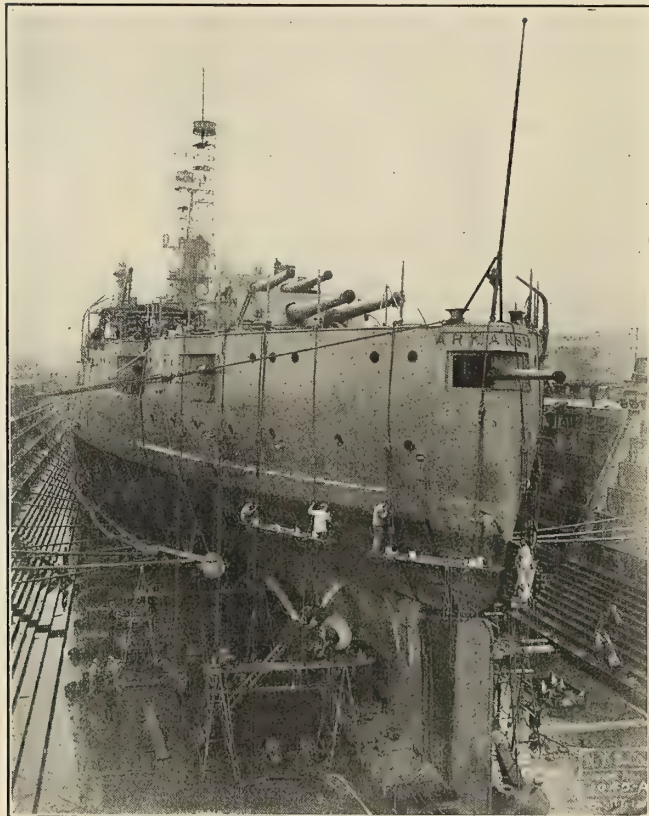


FIG. 2.—ARKANSAS IN DRYDOCK PREVIOUS TO TRIAL TRIP
(PHOTOGRAPH BY N. Y. SHIPBUILDING CO.)

in davits aft on the port and starboard sides. Each crane is provided with two electric motors—one for turning and the other for hoisting. On the top of each crane is a platform for searchlights.

STEERING ENGINE AND GEAR

The steering engine is located on the lower platform in a compartment just abaft of the engine rooms, access being from the starboard engine room.

The steering engine shaft is led aft to the tiller room, where is located the main steering gear, consisting of a right and left-hand screw, on which are two driving nuts direct connected by side rods to the crossheads on the rudder stock. The screw is operated through gearing by either the steering engine or the emergency hand steering gear, either of which may be disconnected when not in use.

ENGINE DATA

	Arkansas. Hyde Windlass Co., inclined engine.	Wyoming. Williamson Bros., vertical engine.
Type.....		
Cylinders, number.....	2	2
Diameter, inches.....	18	21
Stroke, inches.....	14	16

ANCHOR WINDLASS

This engine is located on the upper platform forward. It has two vertical shafts driven by worm gearing direct from a worm on the engine crankshaft. Each vertical shaft has at its upper end, at the main deck, a wildcat that are arranged to operate together or independently of each other.

ENGINE DATA

	Arkansas. Hyde Windlass Co., horizontal engine.	Wyoming. Williamson Bros., horizontal engine.
Type.....		
Cylinders, number.....	2	2
Diameter, inches.....	17	16
Stroke, inches.....	14	16

COALING ENGINES AND GEAR

This outfit consists of two engines located on the gun-deck amidships. Each engine, through miter gears, drives an athwartship shaft, which in turn drives port and starboard fore- and aft shafts, to which are geared five winch heads each, that can be thrown in or out of gear at will. The athwartship shafts are cross-connected so that either engine can operate all winch heads if necessary.

ENGINE DATA

	Arkansas. Hyde Windlass Co., vertical engine.	Wyoming. Williamson Bros., vertical engine.
Type.....		
Cylinders, number.....	2	2
Diameter, inches.....	12	9
Stroke, inches.....	10	9

MISCELLANEOUS MACHINERY

The usual complete equipment of motor-driven deck winches, laundry and culinary machinery, flushing and fresh water pumps, ammunition hoists and conveyors, turret hoists, rammers, training and elevating gear, torpedo air compressors and fire-room elevators are provided.

Fire Main—A complete fire main system is led throughout the vessel, with fire plugs at convenient locations on the various decks. The main is supplied by seven fire pumps located in the engine and fire-rooms. The two distiller circulating pumps can also be used as fire pumps in emergencies.

Sanitary System—The main sanitary system is supplied by the engine and fire-room fire and bilge pumps. It connects to all officers' lavatories, petty officers' and firemen's wash rooms, galleys, ash chutes, sick bay, baths, laundry, etc.

Aft there is an independent system for the crew's water closet and wash room on the gun-deck aft, which is supplied by two electrically-driven centrifugal pumps. Both systems have by-pass connections from the fire main for emergency use.

Fresh Water System—The fresh water system leads to all pantries, lavatories, galleys, laundry, etc. It is normally supplied by gravity tanks, two electrically-driven pumps being provided for filling these tanks from the main ship's tanks. The pumps can also be used for supplying the system should any or all the gravity tanks be out of commission.

Drainage System—The main drain is 15½ inches in diameter throughout its length. It extends from the after bulkhead of the forward fire-room in a single pipe along the starboard outboard side to the forward bulkhead of the starboard engine room, at which point it joins the engine room sections, which are cross-connected and lead to the main circulating pumps.

In each engine room there is a 5½-inch secondary drain connected to the fire and bilge pumps. It has branches to the bilge wells, main drain, shaft alleys and compartments aft, including trimming tanks and double bottoms.

A 5½-inch secondary drain independent of the former extends through the fire-rooms. It is connected to the fire and bilge pumps and has branches to the bilge wells, double bottoms, compartments forward and the forward trimming tanks.

In addition to the former there is a 5-inch independent

drain in each fire-room direct connected to the fire and bilge pump in same compartment.

Ventilation—Artificial ventilation is provided for all quarters, living spaces and compartments requiring same. The air is supplied on the plenum system, except for the toilet spaces, where the exhaust system is used. The system comprises motor-driven fans located at convenient points throughout the vessel, from which the air ducts radiate to the various spaces to be ventilated.

Heating System—The staterooms, quarters and crew's spaces are heated by the ventilating system, steam coil thermo-tanks being introduced in the air ducts for heating the air supplied these spaces. The thermo-tanks can be by-passed when desired.

All other parts of the vessel to be heated are provided with the usual pipe-coil radiators.

MAIN ENGINES

The propelling machinery consists of Parsons turbines, designed to run at 330 revolutions per minute when developing 28,000 shaft-horsepower. They are arranged on four lines of shafting, as shown in sketch, Fig. 3.

The arrangement provides six ahead and four astern tur-

and expanded successively through the I. P. C. turbine, medium high-pressure turbines and the low-pressure ahead turbines, exhausting into the condensers; the astern turbines revolving idly in a vacuum.

For astern motion all four astern turbines are used. The outboard shafts are driven by the high-pressure astern turbines and the inboard shafts by the low-pressure astern turbines, steam being admitted to the former and expanded through the latter into the condensers. Under this condition all the ahead turbines revolve idly in a vacuum.

Non-return valves are fitted in the receiver pipes between the H. P. C. and I. P. C. turbines, and between the I. P. C. and medium high-pressure turbines, as shown in Fig. 3, to prevent back flow of steam when changing from the low to high-speed cruising combination, or from high cruising to full-speed conditions.

The turbines are controlled at the working platforms at forward end of engine rooms, where the regulating valves for admitting steam to the different turbines are located.

Turbines—Each turbine is composed of two essential parts; first, the fixed part or cylinder, and, second, the moving part or rotor. In the cylinder are mounted the guide blades and on the rotor the moving blades. The cylinders are of hard,

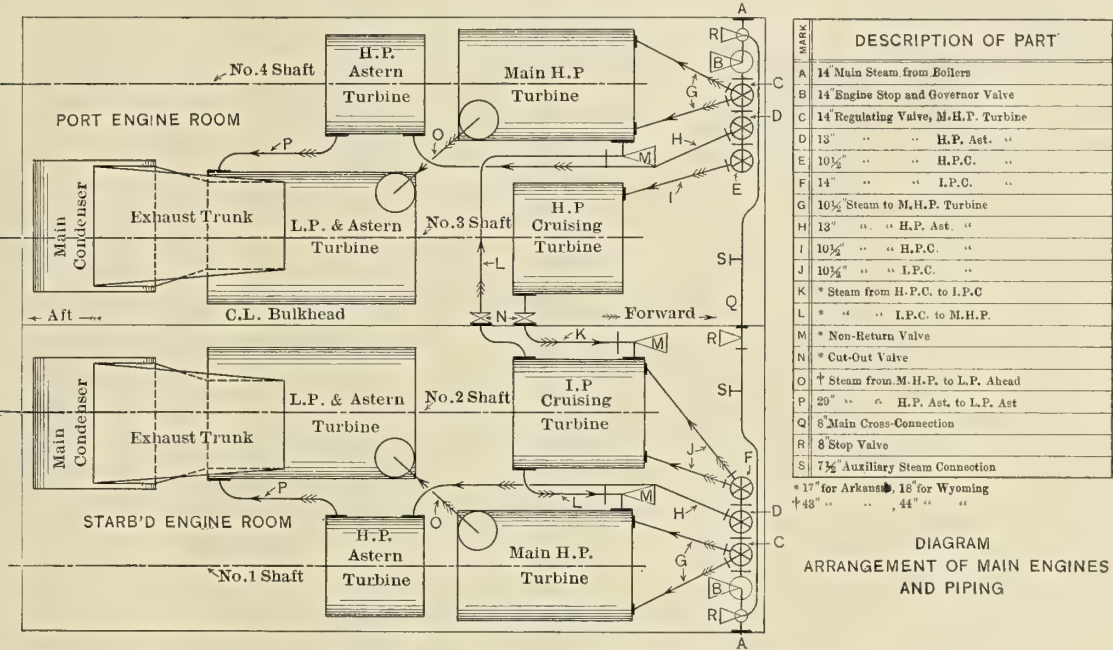


FIG. 3.—SKETCH OF MACHINERY ARRANGEMENT ON THE ARKANSAS AND WYOMING

bines, each low-pressure turbine embodying an astern turbine in the after end of its casing.

For ahead motion the outboard shafts are driven by the medium high-pressure turbines, and the inboard shafts by the low-pressure ahead turbines alone, or in combination with the I. P. C. and H. P. C. turbines, as described in the following paragraphs:

Full Speed Ahead—Only four turbines are used for this purpose, steam being admitted to the medium high-pressure turbines, and expanded through the low-pressure ahead turbines into the condensers. Under this condition the astern and cruising turbines revolve idly in a vacuum, which is maintained through the drain connections.

High Cruising Speeds—Five turbines are used at these speeds, steam being admitted to the I. P. C. turbine, thence through the medium high-pressure turbines and the low-pressure ahead turbines, exhausting into the condensers; the remaining turbines revolving idly in a vacuum.

Low Cruising Speeds—All six ahead turbines are used for this combination, steam being admitted to the H. P. C. turbine

close-grained cast iron, divided into two parts at the axis on a horizontal plane, the lower half being provided with feet for bolting to the seating. Each rotor is built up of a drum of forged steel, securely fastened to a cast steel wheel at each end, that is, shrunk on and keyed to the rotor shaft.

The dummies and rotor shaft glands are steam-packed with the usual labyrinth packing. A micrometer for measuring the dummy clearances is provided at the forward end of each ahead turbine.

Main Bearings—There is a main bearing at each end of each turbine for supporting the rotor. All bearings consist of a pedestal bolted to the turbine casing, except those for the high-pressure astern turbines, which are cast solid with the casing and fitted with bottom brass and cap.

Thrust Block—Each turbine, except the high-pressure astern, is provided with a thrust block at the forward end, consisting of a number of brass rings, in halves, fitted into corresponding collars on the shaft. The lower half of each bearing is for taking the ahead and the upper half the astern thrust.

All main bearings, thrust bearings and line-shaft bearings are fitted with a closed system of forced lubrication, as described later.

Governor—Each line of shafting is provided with a governor designed to operate at about 400 revolutions of the main turbines.

Turning Gear—A power turning gear is fitted to each line of shafting. That for the *Arkansas* is electric, consisting of a 10-horsepower reversible Diehl motor for each shaft, and for the *Wyoming* steam engines are used, each being a double engine with cylinders 4 inches in diameter by 4 inches stroke. Provision is also made for turning by hand with a ratchet.

Lifting Gear—An efficient lifting gear is provided for all turbines. The lifting mechanism is hand operated.

SHAFTING

There are four lines of shafting, a pair port and starboard, respectively.

The outboard shafts are in two sections each, consisting

of one line shaft supported by a spring bearing and a propeller shaft, extending through the stern tube and supported by the strut and stern-tube bearings. The inboard shafting is in four sections each, there being two line shafts supported by three spring bearings, one stern-tube shaft carried by the stern-tube bearings, and a propeller shaft supported by one strut bearing.

All stern-tube and strut bearings are lined with lignum vitae, and the shafts are composition bushed at these bearings. The shafting within the stern tube is covered with a composition casing.

The inboard coupling consists of a sleeve, secured by four keys and two half collars or segments to the stern tube shaft and to the coupling disk on the line shaft by fitted bolts.

The outboard coupling is of the split-sleeve type, consisting of two half sleeves secured to each shaft by two keys, the half sleeves being secured together by bolts.

Shaft Data—Where differences exist both figures are given, the letters A and W being used to designate *Arkansas* or *Wyoming*, respectively.

MAIN TURBINE DATA.

Motor drums:	ARKANSAS.				WYOMING.			
	Diameter.		Length.		Diameter.		Length.	
Main H. P., inches.....	71	114			74	109 $\frac{1}{2}$		
H. P. cruising, inches.....	71	63 $\frac{1}{2}$			73	63 $\frac{1}{2}$		
I. P. cruising, inches.....	70	72 $\frac{1}{2}$			72	72 $\frac{1}{2}$		
L. P. ahead, inches.....	97	87 $\frac{3}{4}$			101	87 $\frac{3}{4}$		
H. P. astern, inches.....	71	30 $\frac{1}{4}$			71	30 $\frac{1}{4}$		
L. P. astern, inches.....	71	44 $\frac{1}{2}$			71	44 $\frac{1}{2}$		
Number of expansions:								
Main H. P. and L. P. ahead, each.....	6				6			
H. P. C. and I. P. C., each.....	3				3			
H. P. astern and L. P. astern, each.....	4				4			
Turbine casings, diameter, inches, each expansion:								
Main H. P.....	73 $\frac{1}{2}$	74 $\frac{1}{2}$	75 $\frac{1}{2}$	77 $\frac{1}{2}$	80	83 $\frac{1}{2}$		
L. P. ahead.....	107 $\frac{1}{2}$	111 $\frac{1}{2}$	117 $\frac{1}{2}$	128	128	128	111 $\frac{1}{2}$	115 $\frac{1}{2}$
H. P. C.....				72 $\frac{1}{4}$	72 $\frac{5}{8}$	73 $\frac{1}{2}$		
I. P. C.....				72 $\frac{1}{2}$	73 $\frac{1}{4}$	74 $\frac{1}{4}$		
H. P. astern.....		72 $\frac{3}{4}$	73 $\frac{3}{4}$	75	77			
L. P. astern.....		80	83 $\frac{1}{2}$	83 $\frac{1}{2}$	83 $\frac{1}{2}$			
Length of casing for each expansion and diameter noted above:								
Main H. P., inches.....	17 $\frac{1}{8}$	17	17 $\frac{13}{16}$	18 $\frac{5}{8}$	19 $\frac{1}{2}$	24 $\frac{9}{16}$	17 $\frac{1}{4}$	17
L. P. ahead, inches.....	12 $\frac{13}{16}$	13	15 $\frac{3}{16}$	15 $\frac{1}{4}$	15 $\frac{1}{2}$	16 $\frac{1}{2}$	12 $\frac{13}{16}$	13
H. P. C., inches.....				18 $\frac{1}{2}$	18 $\frac{1}{2}$	25 $\frac{1}{2}$		
I. P. C., inches.....				23 $\frac{1}{2}$	23 $\frac{1}{2}$	24 $\frac{3}{4}$		
H. P. astern, inches.....		9 $\frac{1}{4}$	8 $\frac{3}{4}$	8 $\frac{3}{4}$	9			
L. P. astern, inches.....		9 $\frac{1}{4}$	11 $\frac{5}{16}$	10 $\frac{5}{16}$	13 $\frac{1}{8}$			
Rows of blading for each expansion:								
Main H. P.....	13						13	
L. P. ahead.....	3 of 7	3 of 7					3 of 7	3 of 6
H. P. C.....	20						20	
I. P. C.....	18						18	
H. P. astern.....	6						6	
L. P. astern.....	5						5	
Length of blades for each expansion, inches:								
Main H. P.....	1 $\frac{5}{8}$	1 $\frac{5}{8}$	2 $\frac{1}{4}$	3 $\frac{1}{4}$	4 $\frac{1}{2}$	6 $\frac{1}{4}$	1 $\frac{5}{8}$	1 $\frac{5}{8}$
L. P. ahead.....	5 $\frac{1}{4}$	7 $\frac{1}{4}$	10 $\frac{1}{4}$	13 $\frac{1}{2}$	13 $\frac{1}{2}$	13 $\frac{1}{2}$	5 $\frac{1}{4}$	7 $\frac{1}{4}$
H. P. C.....				1 $\frac{1}{16}$	1 $\frac{1}{16}$	1 $\frac{1}{16}$		
I. P. C.....				1 $\frac{1}{4}$	1 $\frac{1}{4}$	2 $\frac{1}{8}$		
H. P. astern.....		7 $\frac{1}{8}$	1 $\frac{1}{8}$	2	3			
L. P. astern.....		4 $\frac{1}{2}$	6 $\frac{1}{4}$	6 $\frac{1}{4}$	6 $\frac{1}{4}$			
Rotor shaft and bearings:								
	Length of Bearing, White Metal, Inches.	Diameter of Shaft at Bearings, Inches.	Diameter Axial, Inches.	Length Over All of Rotor Drum and Shaft, Feet and Inches.	Length of Bearing, White Metal, Inches.	Diameter of Shaft at Bearings, Inches.	Diameter Axial, Inches.	Length Over All of Rotor Drum and Shaft, Feet and Inches.
Main H. P.....	15	14	9	21—07 $\frac{1}{4}$	15	14	9 and 8	21—04
L. P. ahead.....	24	15	11	25—10 $\frac{1}{2}$	24 $\frac{1}{2}$	15 $\frac{1}{2}$	10 and 8	26—00 $\frac{3}{4}$
H. P. C.....	12	14	11	15—02 $\frac{1}{4}$	12	14	9	15—02 $\frac{3}{4}$
I. P. C.....	12	14	11	16	12	14	9	16—00 $\frac{3}{4}$
H. P. astern.....	10	14	9	11—02 $\frac{3}{4}$	10	14	9	11—03 $\frac{1}{4}$
L. P. astern.....	24	15	11	With ahead	24 $\frac{1}{2}$	15	11	With ahead
Thrust bearings:								
	M. H. P., Each.	L. P., Ahead, Each.	H. P. C., Each.	I. P. C., Each.	M. H. P., Each.	L. P., Ahead, Each.	H. P. C., Each.	I. P. C., Each.
Collars on shaft, number.....	17	17	8	8	17	17	8	8
Thickness, inch.....	0 $\frac{3}{4}$	0 $\frac{3}{4}$	0 $\frac{3}{4}$	0 $\frac{3}{4}$	0 $\frac{3}{4}$	0 $\frac{3}{4}$	0 $\frac{3}{4}$	0 $\frac{3}{4}$
Distance between, inches.....	1 $\frac{1}{16}$	1 $\frac{1}{16}$	1 $\frac{1}{16}$	1 $\frac{1}{16}$	1 $\frac{1}{16}$	1 $\frac{1}{16}$	1 $\frac{1}{16}$	1 $\frac{1}{16}$
Outside diameter, inches.....	17 $\frac{3}{4}$	17 $\frac{3}{4}$	17 $\frac{3}{4}$	17 $\frac{3}{4}$	18 $\frac{1}{4}$	18 $\frac{1}{4}$	18 $\frac{1}{4}$	18 $\frac{1}{4}$
Inside diameter, inches.....	12 $\frac{1}{2}$	12 $\frac{1}{2}$	12 $\frac{1}{2}$	12 $\frac{1}{2}$	12 $\frac{1}{2}$	12 $\frac{1}{2}$	12 $\frac{1}{2}$	12 $\frac{1}{2}$
Number of shoes, top.....	16	16	7	7	16	16	7	7
Number of shoes, bottom.....	17	17	8	8	17	17	8	8

Line shaft, diameter outside, inches.....	12¾
At journals, inches.....	12¾
Axial hole, inches.....	8
Stern-tube shaft, diameter outside, inches.....	12¾
Axial hole, inches.....	7¼
Propeller shaft, diameter outside, inches.....	12¾
Axial hole.....	7¼
Couplings, diameter, inches.....	22
Thickness, inches.....	3
Inboard coupling, diameter of sleeve outside, inches.....	22
Inside, inches.....	14½
Length of sleeve, inches..... (W) 10, (A) 12	
Thickness of collars, inches.....	1¾
Coupling bolts, number each coupling.....	8
Diameter (taper)* at face of coupling, inches.....	2¾
Outboard coupling, length of half sleeves, inches.....	48
Bolts securing sleeves, number.....	16
Diameter, inches..... (W) 1¾, (A) 1½	
Spring bearings, diameter, inches.....	12¾
Length, inches..... (W) 18, (A) 22½	
Forward stern-tube bearings, diameter, inches... (W) 14½, (A) 14 9/16	
Length, inches.....	48
After stern-tube bearings, diameter, inches.....	14½
Length, inches.....	60
Strut bearings, diameter, inches.....	14½
Length, inches.....	72

* Parallel bolts for inboard coupling of *Wyoming*.

PROPELLERS

There are four three-bladed propellers, all outboard turning when going ahead. The blades and hubs are of manganese bronze and cast in one piece. The blades are true screw-machined to pitch.

PROPELLER DATA

	Arkansas.	Wyoming.
Diameter of propeller, feet and inches.....	9 7	10 0
Hub, feet and inches.....	2 3	2 0½
Pitch, feet and inches.....	8 2 5/16	8 2.24
Ratio of diameter to pitch.....	1.17	1.22
Area, projected, square feet.....	36.145	41.06
Helicoidal, square feet.....	40.145	46.13
Disk, square feet.....	72.131	78.5
Ratio, projected to disk area.....	0.501	0.523
Helicoidal to disk area.....	0.556	0.558

MAIN CONDENSING APPARATUS

The condensing outfits of each vessel are radically different. That for the *Wyoming* is the Weir uniflex condenser with dual air pump, while the system installed on the *Arkansas* is the ordinary type condenser with Parsons vacuum aug-menter and twin air pump.

Main Condensers—There is one main condenser, located in the after end of each engine room, of the following principal dimensions:

Type	Arkansas. Ordinary cylindrical.	Wyoming Weir Uniflex triangular section.
Maximum width over all, feet and inches.....	9 9	10 2
Depth over all, feet and inches.....	10 0	9 16
Inside diameter, feet and inches.....	11 0	9 9½
Thickness of shell (steel), inches.....	1½	1½
Length between tube sheets, ft. and ins.....	11 0	9 9½
Thickness of tube sheets, inches.....	1	1½
Tubes, number.....	8,466	8,746
Diameter, inches.....	5½	5½
Thickness, B. W. G., No.....	16	16
Cooling surface, square feet.....	15,235	14,007
Exhaust nozzle area, square feet.....	48	48
Diameter air pump suction, inches.....	9	14
Augmenter suction, inches.....	15	29
Circulating water inlet and outlet, ins.....	30	29

Main Air Pumps—An air pump of the following principal dimensions is provided for each main condenser:

Type	Arkansas. Blake, twin, vertical, single-acting.	Wyoming. Weir, vertical, dual pump.
Diameter steam cylinders, inches.....	(2) 17½	(1) 20
Water cylinders, inches.....	(2) 35	(2) 36
Stroke, inches.....	21	21
Diameter, wet suction, inches.....	12	12
Dry suction, inches.....	10	7½
Wet discharge, inches.....	10	10
Dry discharge, inches.....	10	4½

Main Circulating Pumps and Engines—Each main condenser is provided with a circulating pump of the following principal dimensions:

Type pump	Arkansas. Worthington, bi-rotor, volute, centrifugal.	Wyoming. Centrifugal.
Capacity, gallons per minute.....	19,500	19,500
Diameter suction nozzles, inches.....	(2) 21	(2) 21
Discharge nozzles, inches.....	30	29
Impeller, inches.....	(2) 17½	54
Type engine	Terry turbine.	Compound reciprocating.
Diameter H. P. cylinder, inches.....	13	13
L. P. cylinder, inches.....	25	25
Stroke, inches.....	12	12
R. P. M., designed.....	215	215

Augmenter Condenser (Arkansas only)—An augmenter condenser of the following dimensions is installed for each main condenser on the *Arkansas*:

Diameter of shell inside, inches.....	29
Thickness of shell (composition), inches.....	5/16
Length between tube sheets, inches.....	48
Thickness of tube sheets, inches.....	1
Tubes, number.....	685
Diameter, inches.....	5½
Thickness, B. W. G.....	16
Diameter of vapor inlet, inches.....	13
Air-pump suction.....	12
Circulating water inlet and outlet, inches.....	6

FEED AND FILTER TANK

A feed and filter tank of about 4,000 gallons capacity is located at a high level in each engine room. The filter chamber is in the top of the tank and has a capacity of about 700 gallons. The filter has an inner bottom of loose perforated plates and is divided into compartments, in which is placed the filtering material, by vertical division plates. These partitions are so arranged that the water in passing through the filter will flow under and over in succession.

ENGINE ROOM AUXILIARIES

Auxiliary Condenser, Air and Circulating Pumps—There is an auxiliary condenser in each engine room of about 725 square feet of cooling surface, connected through the auxiliary exhaust pipe to all the auxiliary machinery. Each condenser has a 7½-inch by 4-inch by 12-inch independent air pump of the Blake vertical, simplex, double-acting, feather-weight type and an independent circulating pump as follows:

Type pump	Arkansas. Alberger, volute.	Wyoming. Centrifugal.
Diameter of impeller, inches.....	10	26
Suction and discharge, inches.....	6	6
Type engine	Alberger turbine.	Reciprocating single-cylinder.
Diameter cylinder, inches.....	5	5
Stroke, inches.....	6	6

Feed-Water Heater—A feed-water heater, complete with all the necessary fittings, is located in each engine room on the discharge side of the main feed pumps. The heating agent is the exhaust steam, a back pressure being kept in the auxiliary exhaust line for this purpose by means of a spring relief valve at each condenser connection, opening toward the condenser. The heaters on the *Arkansas* are of the Schutte-Köerting film type of 257.6 square feet of heating surface each, and those on the *Wyoming* are of the Alberger Condenser Company triple-flow type, of 900 square feet heating surface each.

Main Feed Pumps—Two 14½-inch by 9½-inch by 18-inch main feed pumps of the Blake vertical, double-acting, single type are located in each engine room. The pumps have suctions from the main feed tanks and discharge to the boilers through the feed-water heaters or by-pass same.

Reserve Feed-Water Pump—A small reserve feed-water pump is fitted in the port engine room for use in port to pump make-up feed-water from the reserve feed tanks into the main feed tanks. The pump is a 6-inch by 6½-inch by 12-inch Blake, vertical, double-acting single type.

Fire and Bilge Pumps—Two Blake 12-inch by 10-inch by 18-inch vertical, double-acting, single fire and bilge pumps are provided in each engine room. They are arranged to draw water from the drainage system and sea, and discharge to the fire main, sanitary system and overboard.

Pipe Insulator Pumps—In each engine room is a 6-inch by 8-inch by 8-inch Blake vertical, double-acting, single pump for circulating water around the main steam pipe flange at bulk-heads near magazines to prevent the transmission of heat through the ship's structure to the magazines.

Water Service—Conveniently located hose connections are provided in the engine rooms and shaft alleys for supplying water to the bearings and other parts that may require cooling.

Forced Lubrication—There is a complete system of forced lubrication in each engine room for the main, thrust and line shaft bearings and the main circulating pump engines.

The installation in each engine room embraces two 10-inch by 9-inch by 12-inch Blake vertical, double-acting, single oil pumps; three Schutte-Koerting film oil coolers on the *Arkansas* and one Alberger oil cooler on the *Wyoming*; one (8-inch by 7-inch by 8-inch on the *Arkansas* and 10-inch by 9-inch by 12-inch on the *Wyoming*) Blake vertical, double-acting, single circulating pump for the oil coolers; one oil drain tank of about 350 gallons capacity and the necessary piping and fittings.

The system functions as follows: The oil pumps draw oil from the drain tanks and deliver same via the oil coolers, or by-passing same, to the various bearings at a pressure of about 15 pounds per square inch. After the oil has passed through the bearings it is caught in troughs formed in the bases of the bearings and drained by gravity back to the drain tank, whence the cycle is repeated.

Settling tanks for cleaning the oil and oil storage tanks are provided in each engine room.

BOILERS

The boilers, twelve in number, are of the Babcock & Wilcox watertube type, arranged in batteries of four each in three separate watertight compartments. They are designed to run the entire machinery installation at full power, with an average air pressure in the ash pits of not more than 2 inches of water.

The boilers are equipped for burning both coal and fuel oil.

The up-takes are of the usual design, and there are two smokestacks, each about 92 feet in height above the grates and 11 feet 6 inches in diameter.

Boiler Data—Where differences exist both figures are given, the letters A and W being used to designate *Arkansas* or *Wyoming*, respectively.

Number	12
Working pressure, pounds per square inch	210
Test pressure, pounds per square inch	315
Height to top of drum, feet and inches	13 10 1/4
Length on floor, feet and inches	9 01 1/2
Width on floor, feet and inches	18 04 1/2
Drum, diameter, inches	42
Length, overheads, feet and inches	20 02 1/4
Thickness, inch	90 11-16
Number of furnaces, each boiler	1
Furnace doors, each boiler	5
Grates, length, feet and inches	7 00
Width, feet and inches	17 00
Total grate surface, square feet	1,428
Total heating surface, square feet	64,234
Ratio, G.S., to H.S.	1 to 44.98
Number of tube sections, each boiler	31
2-inch tubes, each boiler	1,100
4-inch tubes, each boiler	62
Distance between headers, feet and inches	8 00
Area of each smoke-pipe, mean, square feet	(A) 102.07, (W) 103.87
G.S. ÷ area through smokestacks	(A) 7 (W) 6.87
Kind of forced draft	Closed fire-room.
Number of oil burners, each boiler	(A) 4, (W) 8
Type of oil burners	(A) Schutte-Koerting, (W) Peabody
Dry pipe, diameter, inches	6
Steam stop valve, diameter, inches	5 1/2
Triple safety valve, diameter each valve, inches	4
Feed stop and check valves, main and auxiliary, diameter, inches	2 1/2
Surface blow valve	1 1/2
Bottom blow valves	1 1/2

FUEL OIL SYSTEM

As auxiliary to the usual coal-burning appliances, a complete oil-burning system is provided. The plant consists of two 7 1/2-inch by 4-inch by 8-inch Blake heavy-pressure, vertical, double-acting duplex pumps, one in each engine room on the center line bulkhead. These pumps draw the fuel oil from the double-bottom tanks, located under the space between the engine rooms and the fire-rooms, and deliver same to the oil burners on the boilers.

There are two oil heaters of the Schutte-Koerting film type in each fire-room on the *Arkansas*, and one of Cramp's design in each fire-room on the *Wyoming*, through which the oil is delivered to the burners in the same fire-room. The heating surface of the two type heaters is 10.4 square feet and 23.29 square feet each, respectively. The oil may be by-passed around the heaters if necessary. There are cut-out valves in

the supply pipe to each pair of boilers, fitted with emergency deck-operating gear.

FIRE-ROOM AUXILIARIES

Forced-Draft Blowers—Four forced-draft blowers are installed for each fire-room. They are located in specially constructed blower rooms just below the protective deck and above the center of each fire-room. The fans are in two sections each, of the Sturtevant multivane type, and each is driven by an electric motor controlled from the working level or the blower room at will. Air is supplied from the fire-room ventilators. The fan motor data are as follows:

	<i>Arkansas</i> , Diehl.	<i>Wyoming</i> , G. E.
Type motor	890	965
Revolutions per minute	33	45
Horsepower, each	26 1/2	29 1/4
Fan, diameter, inches	14 1/2	16 1/16
Width, each section, inches	60	36
Number of blades, each section		

Auxiliary Feed Pumps—There are three 14 1/2-inch by 9 1/2-inch by 18-inch auxiliary feed pumps, one in each fire-room. They are of the Blake vertical, double-acting, single-type, and are arranged so that any pump can feed any boiler.

Fire and Bilge Pumps—In each fire-room there is a Blake 12-inch by 10-inch by 18-inch vertical, double-acting, single fire and bilge pump, arranged to draw water from the bilge, the drainage system and the sea, and discharge to the fire main, sanitary system and overboard.

Ash Hoists—The port ventilator in each boiler compartment is fitted with all the necessary gear for hoisting ashes. There are three ash-hoist engines of the two-cylinder reversible type, one for each fire-room, located in the upper fire-room hatches. The cylinders are each 4 1/2 inches in diameter by 4 1/2 inches stroke. The hoists are operated from the main deck, where are located the ash chutes at the ship's side.

In addition to the ash hoist the following ash-handling apparatus is provided:

Ash Ejectors (*Arkansas only*)—Two 6-inch hydraulic ash ejectors, one port and the other starboard, discharging above the waterline, are provided in each fire-room. The water for discharging the ashes overboard is supplied by three 14-inch by 8 1/2-inch by 12-inch Warren vertical, duplex, double-acting pumps, one in each fire-room.

Ash Expellers (*Wyoming only*)—A Metten hydraulic ash expeller, discharging through the bottom of the vessel, is fitted in each fire-room. Each expeller is provided with a De Laval steam turbine-driven centrifugal pump for discharging the ashes overboard.

PIPING SYSTEMS

Main Steam Piping—The main steam piping is arranged in two symmetrical systems, one on each side of the vessel. The two lines are cross-connected in the forward fire-room and in the engine rooms. The branches from the boilers are 5 1/2 inches in diameter each, and the lines proper are 7 1/2 inches in the forward fire-room, increasing to 9 1/2, 11, 12 1/2 and 14 inches at each successive boiler connection. In the pipe passages, between the engine and fire-rooms, it is increased to 14 1/2 inches in diameter and again reduced to 14 inches in the engine rooms. No steam separators are fitted.

Auxiliary Steam Piping—A 7 1/2-inch auxiliary steam line, forming a connecting loop between the two sides of the ship, is led from the engine room main steam cross-connection through the engine rooms. From this line steam connections are taken for the various engine room auxiliaries, steering engine, etc.

In the fire-rooms the auxiliary steam consists of a small cross-connection between the port and starboard main steam lines, from which the branches to the auxiliaries are taken.

Steam connections for the forward dynamos and deck machinery forward are taken off the main steam cross-connection in the forward fire-room.

The after dynamos are supplied through connections from the main steam pipes in the after fire-room.

Auxiliary Exhaust Pipe—An auxiliary exhaust pipe is fitted throughout the machinery spaces and elsewhere as required for the various auxiliaries. Connections are provided to direct the exhaust steam into either the main or auxiliary condensers, either feed-water heater, or into the atmosphere through the after escape pipe at will. There are also connections for admitting the exhaust steam into the steam belts of the medium high-pressure and low-pressure ahead turbines when desired.

Main and Auxiliary Feed Pipes—The main feed pumps in the engine rooms take their suction from the main feed tanks and discharge via the feed-water heater, or by-pass same, to the boilers. There is a suction main from the main feed tanks to the auxiliary feed pumps in the boiler rooms. These pumps have direct connections to the boilers in their respective compartments, or can discharge into the main feed line to any boiler.

INTERIOR COMMUNICATION

The customary engine and fire-room telegraphs, gongs, time-fire device, telephones, voice tubes, etc., are fitted for transmitting orders and signaling to the various machinery compartments and other parts of the vessel.

AIR COMPRESSOR PLANT

Located in the engine room are nine* 11-inch by 11-inch by 12-inch Westinghouse steam-driven air compressors and two air reservoirs of about 45,000 cubic inches capacity each, for use in running pneumatic tools in the engineering department, blowing soot off the boiler tubes and for the gas-ejecting system for the guns.

Each compressor has a capacity of about 300 cubic feet of free air per minute at 150 pounds pressure.

A pneumatic main, independent of the gun gas-ejecting system, is led throughout the machinery space, with branches to the workshop, evaporator and dynamo rooms, from which the connections for pneumatic tools and blowing soot off boiler tubes are taken.

EVAPORATING AND DISTILLING APPARATUS

This plant is located on the berth deck, just forward of No. 3 turret, with the distillers in the evaporator room hatches at the gun-deck level. There are four evaporators of 312 square feet heating surface each, four distillers of 125 square feet of cooling surface each, and two evaporator feed-water heaters, with their accessories arranged to operate in double effect. The plant has a combined capacity of 25,000 gallons of water per twenty-four hours.

The following pumps, of the Blake vertical, double-acting, single type, are provided:

Two evaporator feed pumps, 4½ inches by 5 inches by 6 inches.

One distiller fresh-water pump, 4½ inches by 5 inches by 6 inches.

Two distiller circulating pumps, 12 inches by 14 inches by 16 inches.

MACHINE SHOP

A well-equipped machine shop is located amidships between the engine hatches on the berth deck. The necessary machine tools for performing general repairs are provided. The tools are of the latest type, and each is driven by an independent electric motor.

There is also a well-equipped blacksmith shop and small foundry located on the main deck amidships.

ELECTRIC PLANT

There are two dynamo rooms located on the lower plat-

form, one forward and the other aft of the boiler compartments.

The generator installation in each dynamo room consists of two six-pole, compound-wound, 300-kilowatt General Electric generators, each driven by a two-stage horizontal Curtis turbine. Each generator will deliver at normal load 2,400 amperes of current at 125 volts when running at 1,500 revolutions per minute.

There is one condenser in each dynamo room for the exclusive use of the dynamo equipment. Each condenser has its independent air and centrifugal circulating pump and hot-well tank and pump.

The condenser and pump data are as follows:

CONDENSER DATA		
	Arkansas.	Wyoming.
Diameter inside shell, feet and inches..	4 10	4 0½
Thickness of shell, inches.....	¾	5/16
Length between tube sheets, ft. and ins.	6 8½	7 3
Thickness of tube sheets, inches.....	1	1
Tubes, number	2,190	1,529
Diameter, inches	¾	¾
Thickness, B. W. G.....	16	16
Diameter exhaust nozzles, inches..	(2) 19	(2) 20
Air pump-suction, inches.....	(1) 6	(2) 5
Circulating water inlet and outlet, inches	9	10
Cooling surface, square feet.....	2,403	1,813.5

CIRCULATING PUMP AND ENGINE DATA		
Type	Centrifugal.	Centrifugal.
Diameter impeller, inches.....	21	.28
Steam cylinder, inches	6	5
Stroke, inches	6	6

Air Pumps—9-inch by 18-inch by 12-inch Blake vertical, twin, beam, single-acting, single steam cylinder.

Hotwell Pumps—4½-inch by 5-inch by 6-inch Blake vertical, double-acting, single.

REFRIGERATING PLANT

There are five Allen dense-air ice machines, each capable of producing the cooling effect of 3 tons of ice per day. Two of the ice machines are located—one forward and the other amidships—for the forward and amidships magazine cooling systems. The three other ice machines are located just aft of the engine room hatches, one on the starboard and two on the port sides, and are fitted for cold-storage service, ice making and for the after magazine cooling systems. The piping is so arranged that any ice machine can be used on any magazine cooling system in emergencies.

There are four refrigerating rooms isolated by air locks and insulated with cork in the usual manner.

TORSION METERS

Each line of shafting is fitted with a Gary-Cummings torsion meter for ascertaining the shaft-horsepower of the main turbines.

TRIALS

The contracts required five trials, as follows:

(a) A progressive trial over a measured mile course for standardizing the screws.

(b) A full-speed trial of four hours' duration in the open sea at the highest speed obtainable, with an average air pressure in the ash pits not exceeding 2 inches of water and not over 175 pounds steam pressure above the atmosphere at the medium high-pressure turbine. The average speed to be at least 20.5 knots.

(c) An endurance and coal-and-water-consumption trial of twenty-four hours' duration in the open sea, at as nearly as possible a uniform speed of 19 knots, the average not to fall below that figure. The trial to be conducted as nearly as possible under cruising conditions.

(d) An endurance and coal-and-water-consumption trial at 12 knots, under similar conditions to the preceding trial.

(e) A trial of two hours' duration at the highest speed obtainable, burning coal and fuel oil in combination.

The *Arkansas*' trials took place early last June, and the *Wyoming*'s were just completed the middle of July.

* 9 for *Arkansas*; 8 for *Wyoming*.

The standardization trials of both vessels were run on the measured mile course at Rockland, Me. The weather was favorable on both occasions and the trials were most satisfactory. The maximum corrected speeds attained were 21.196 knots for the *Arkansas* and 21.323 knots for the *Wyoming*. A graphic comparison between the performances of the two vessels is given in Fig. 4. From the data obtained it was found to require 310.9 revolutions per minute of the main turbines to attain the contract speed of 20.5 knots, 284.4 revolutions per minute for 19 knots and 175.8 revolutions per minute for 12 knots for the *Arkansas*, and 302.5, 279.5 and 171.2 revolutions per minute, respectively, for the *Wyoming*.

All other trials were run in the open sea off the North Atlantic coast. Excellent weather prevailed throughout the trials, which were successfully conducted and all requirements easily met. Unfortunately, an accident to the H. P. C. turbine on the *Arkansas*, which occurred on the standardization

The United States battleship *Pennsylvania*, authorized by act of Congress Aug. 22, is to have the following main characteristics: Length, 600 feet; beam, 97 feet; draft, about 28 feet 6 inches; displacement, about 31,000 tons; main battery, twelve 14-inch guns and four submerged torpedo tubes; secondary battery, twenty-two 5-inch guns. The vessel will be heavily armored and will have oil-burning boilers of the watertube type. The type of machinery has not yet been definitely determined, although it is expected that the speed of the vessel will slightly exceed the fastest American battleships. The cost of the ship, exclusive of armor and armament, will be approximately \$7,425,000 (£1,525,000).

H. M. S. Oak, the third torpedo boat destroyer of the *Firedrake* type built for the British Admiralty by Messrs. Yarrow & Company, of Glasgow, was successfully launched Sept. 5. The *Oak* is 255 feet long, with a beam of 25 feet 7

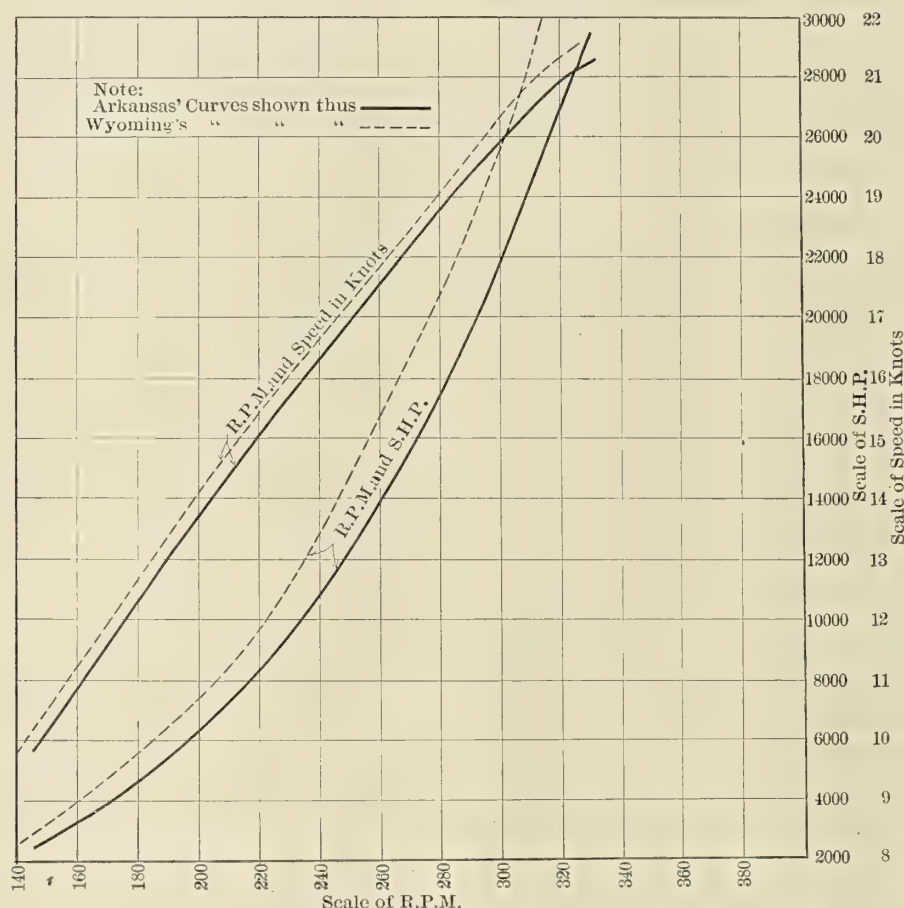


FIG. 4.—SPEED AND POWER CURVES FROM TRIALS OF ARKANSAS AND WYOMING

trial, rendered it necessary to disconnect the turbine for the remaining trials and to conduct the 12-knot endurance trial of that vessel on the five-turbine combination instead of six turbines as intended.

The average figures for shaft-horsepower, revolutions per minute and speed developed on the several trials are given below:

	Arkansas.	Wyoming.
4-hour full-speed trial:		
Shaft horsepower	28,533	31,437
Revolutions per minute	323.8	319.36
Speed in knots	21.05	21.223
24-hour, 19-knot endurance trial:		
Shaft horsepower	20,592	20,784
Revolutions per minute	291.3	282.6
Speed in knots	19.41	19.209
24-hour, 12-knot endurance trial:		
Shaft horsepower	4,354	5,353
Revolutions per minute	175.7	175.09
Speed in knots	11.993	12.266
2-hour coal and oil-burning trial:		
Shaft horsepower	28,043	28,889
Revolutions per minute	322.1	312.31
Speed in knots	20.989	20.979

inches, the propelling machinery consisting of Parsons turbines driving twin screws. Steam is supplied by three of the latest type of Yarrow boilers, fitted with the firm's patent feed heating device and arranged for burning oil fuel exclusively. The contract speed of the vessel is 32 knots.

The steamship *Nantucket*, of the Merchants & Miners' Transportation Company, sank at a railroad pier at Locust Point, Baltimore harbor, Sept. 2, after the lower forward hold of the steamer had been flooded with water to put out a fire which broke out in the cargo. The flooding of the hold caused the cargo to list and the vessel turned over on her beams end.

Vickers, Ltd., of Barrow-in-Furness, has just received a contract for a large oil tank steamer for the British Admiralty. This vessel will be engined with two Carels-Diesel engines.

Motor Ship *Eavestone* Fitted with Carels Diesel Engines

The first large British-built and British-owned Diesel-engined motor ship is the *Eavestone*, the hull of which was built at the yards of Messrs. Sir Raylton Dixon & Company, Middlesbrough, and the engines by Messrs. Richardsons, Westgarth & Company, Ltd., Middlesbrough, in conjunction with Messrs. Carels Bros., Ltd., Ghent, Belgium. The ship is 276 feet long, 40 feet 6 inches beam, displacement about 4,500 tons, deadweight carrying capacity about 3,200 tons. She is a twin-screw vessel with engines aggregating 1,000 horsepower, designed to give the ship a speed of $9\frac{1}{2}$ knots.

The Carels type of engine, with which the ship is fitted, has been developed by Messrs. Carels Bros. in a most prac-

engine, and in order to combine these elements in the design of the marine Diesel engine, Messrs. Carels Bros., before turning their attention to marine work, consulted with the foremost marine engine builders in England, France and Germany, and obtained from them the benefit of expert marine engine construction as a foundation for the design of a practical and reliable marine Diesel engine. The Carels marine Diesel engine, therefore, is the result of the most careful adaptation of good marine engine practice and good oil engine practice.

The appearance of the Carels engine, as can be seen from the photograph and drawings of the *Eavestone's* engines

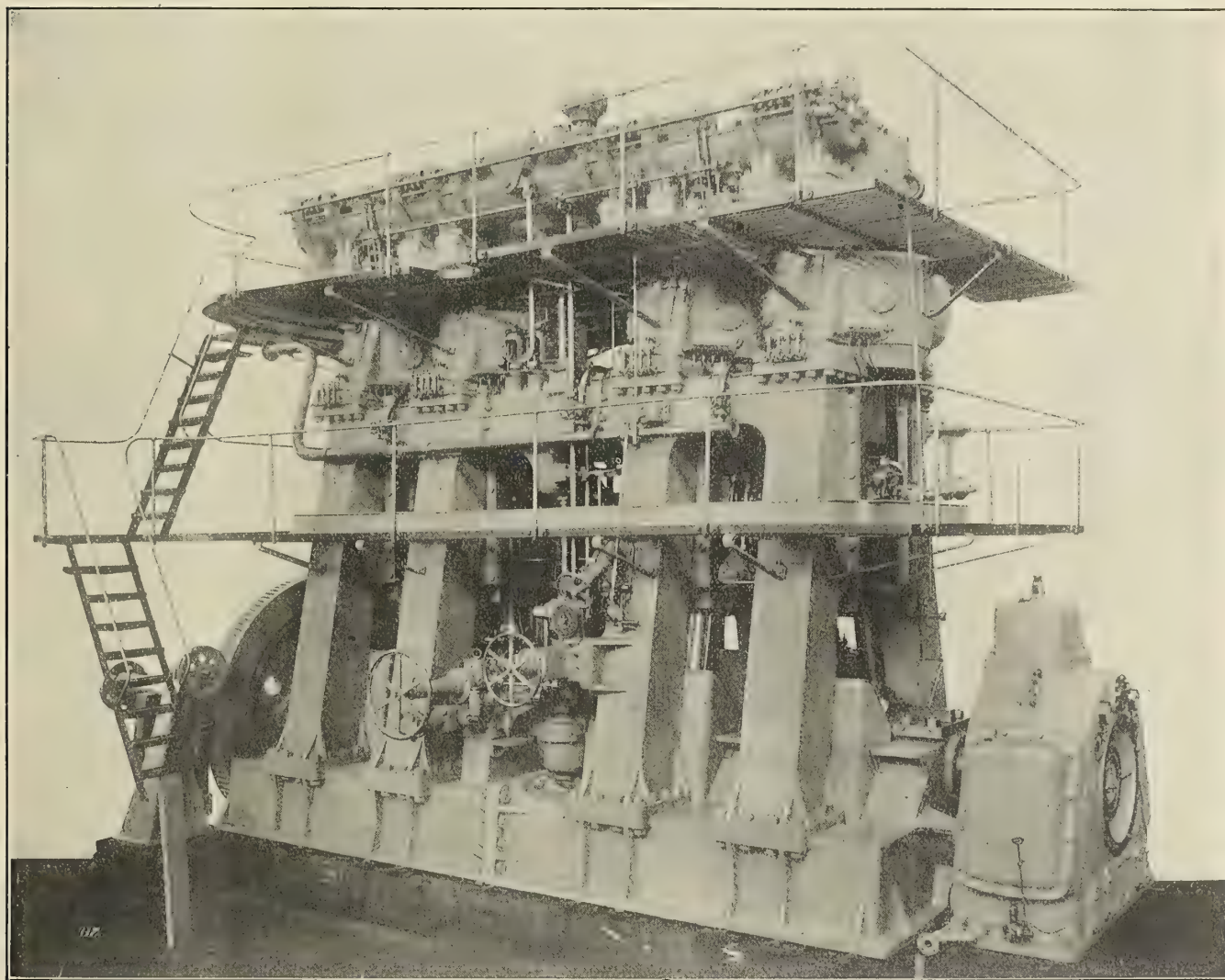


FIG. 1.—CARELS TWO-CYCLE DIESEL ENGINE FOR THE *EAVESTONE*

tical way by combining the results of this firm's previous development of the Diesel engine for stationary purposes with the best marine steam engine practice. It is impossible, of course, to build an oil engine exactly on the lines of a steam engine, because the functions of the two engines are totally different, and different types of valves and valve gear are necessary. Also the design of the cylinders of an oil engine to withstand high-pressures and high temperatures introduces a new problem. The construction of piston rods, crankshafts, bearings, engine framing and bed plates of an oil engine, however, can be made to conform to the design of a steam

shown herewith, is, therefore, about the nearest approach to that of a steam engine that has yet been developed. A close inspection of the drawings will show that the construction of the engine from the bed-plate to the cylinders is practically a reproduction of steam engine design. The cylinders and valve mechanism, however, are in accordance with the successful development of the Diesel engine which this firm developed for stationary work. In the engines for the *Eavestone*, Messrs. Carels Bros. supplied the cylinders and the valve mechanism, while the other parts of the engines were built by Messrs. Richardsons, Westgarth & Company, Ltd. These

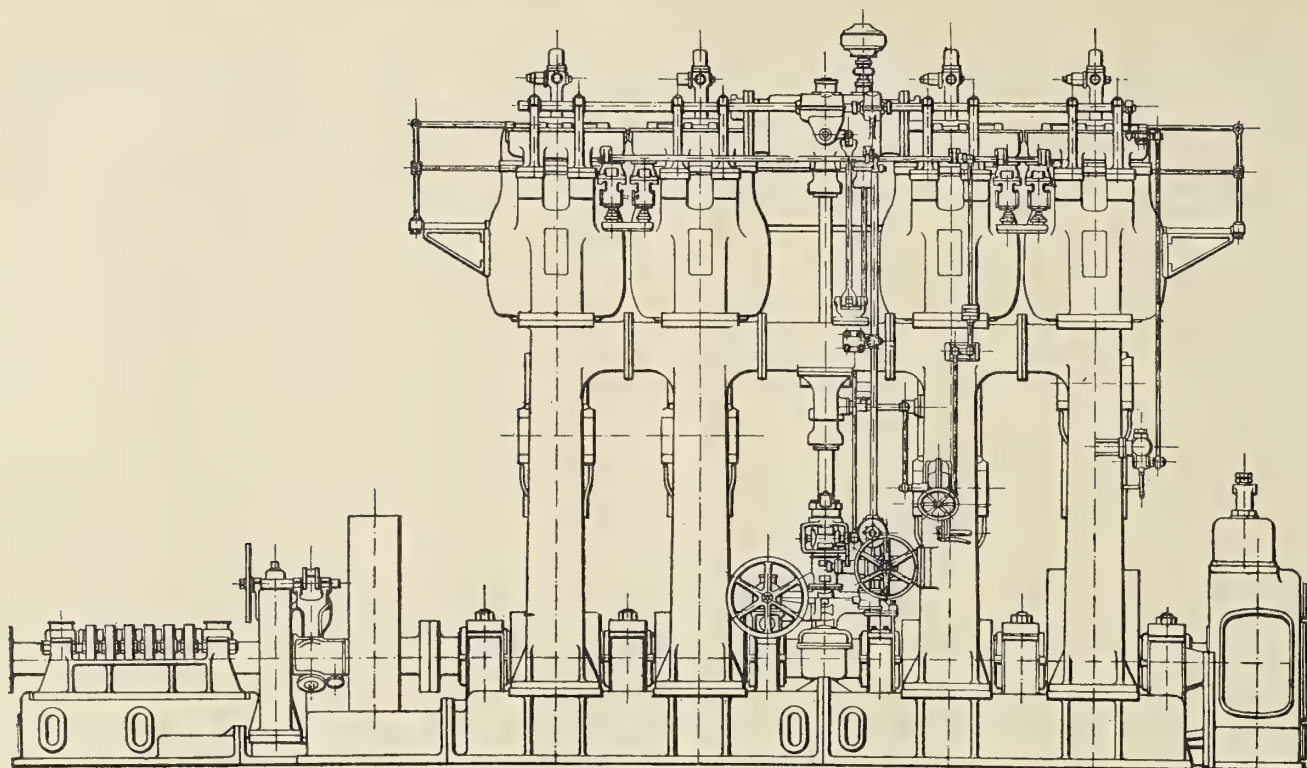


FIG. 2.—FRONT ELEVATION OF CARELS MARINE ENGINE

engines are of the four-cylinder, two-cycle type, with cylinders 20.1 inches diameter and 36.22 inches stroke. At 100 revolutions the total power developed is 1,000 horsepower.

The pistons, which are water cooled, are packed with spring rings of the Ramsbottom type, and work in a liner, which is a separate casting inserted into the outer jacket. At the lower end of the liner is a stuffing-box, which is fitted to prevent any leakage of exhaust gas past the piston into the room. A series of circumferential ports near the bottom of the liner form the exhaust ports, the scavenging and fuel valves are placed in the cylinder cover, all of which is thor-

oughly jacketed for cooling the cylinder head and the valves. There are four scavenging valves in each cylinder, and a fuel oil injection valve, together with an air-starting valve, is placed in the center of the cylinder head. All the valves are operated through levers actuated by cams carried on a shaft which is supported by bearings connected to the cylinder jackets. The cam-shaft itself is actuated by means of a valve shaft and spiral gear wheels at the center of the engine connecting the cam-shaft to the crankshaft.

A fuel oil measuring pump is provided for each cylinder, and is driven from the cam-shaft. The amount of oil fed to the cylinders can be regulated by hand from the stationary platform, and an independent governor control is also provided. There are two sets of cams for the fuel injection and air-starting valves of each cylinder—one set being for ahead and the other set for astern operation. A maneuvering shaft, which runs alongside the cam-shaft, serves to operate the rollers of the valve levers, so that they are brought into contact with the proper cams for running the engine either ahead or astern. The maneuvering shaft is free to slide fore and aft in order to bring the rollers opposite the proper cams. A special motor is provided to change the position of the maneuvering shaft. At the same time the cam-shaft is rotated in order to change the position of the cams operating the scavenging valves in relation to the position of the crankshaft. This is accomplished by raising or lowering the vertical driving shaft by means of a special motor operating through a rack and pinion and connecting rod coupled to a lever secured to a sleeve on the vertical shaft. Both the motor for rotating the cam-shaft and that sliding the maneuvering shaft are operated by compressed air.

Compressed air at high-pressure for the fuel injection is supplied by a multiple-stage air compressor coupled to the forward end of the main crankshaft, while the compressed air for scavenging the cylinders at low-pressure is supplied by double-acting pumps driven by levers from the crosshead of the engine. Other pumps are also operated from the same levers, including the water circulating pumps and the bilge and sanitary pumps.

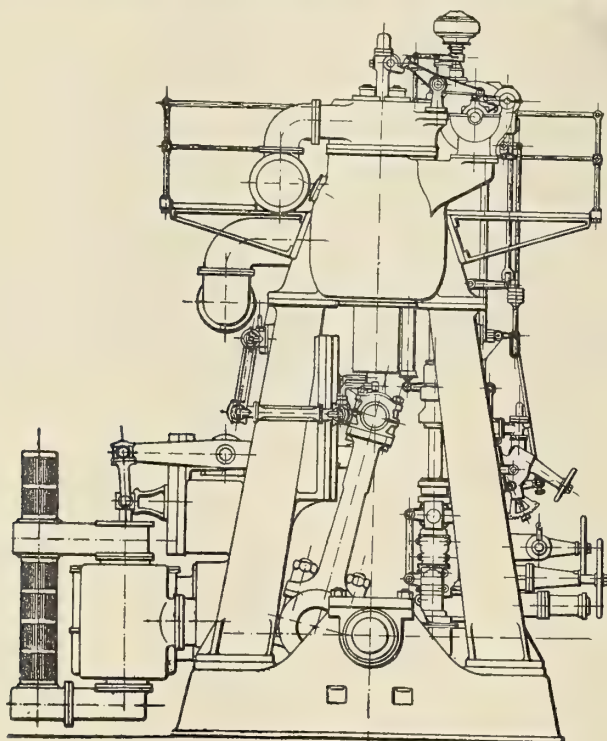


FIG. 3.—END ELEVATION

Lubrication is provided by gravity to all parts of the engine except the pistons, where a forced system is provided.

Complete control of the engine is brought to one point at the starting platform, from which the engine can be started, stopped and reversed in remarkably short time after the signals are received. The controls are so interlocked that it is impossible to operate them except in the proper sequence when starting, stopping or reversing the engine. The time required to reverse from full speed ahead to full speed astern on the trials of the *Evestone* was found to be only eight seconds.

Since completion the *Evestone* has been in continuous service. Her maiden voyage was from Sunderland to Antwerp with a cargo of coal. The voyage was made under splendid conditions, and those who were on board said that the engines were practically noiseless and that the cooling arrangements of the engines were very efficient. The maneuvering qualities of the engines also proved very effective when the vessel was handled in narrow waterways in port.

After discharging her cargo at Antwerp the *Evestone* sailed to West Hartlepool, the voyage being accomplished in heavy weather, during which the engines showed their excellent reliability. It was found unnecessary in spite of the heavy weather to use the oil-regulating levers, and the engine's speed of from 87 to 96 revolutions per minute was maintained throughout the voyage.

At West Hartlepool another cargo of coal was taken on board for the Baltic ports, but before proceeding on the voyage a measured mile trial was carried out, on which the vessel easily made the contract speed of $9\frac{1}{2}$ knots. This speed was made at 93 revolutions per minute, whereas the engines had been found capable of developing a speed of well over 100 revolutions per minute.

Some idea of the advantages gained by the use of Diesel engines in place of steam machinery in a vessel such as the *Evestone* is shown by the fact that in the *Evestone* there is an estimated saving in the weight of the machinery of 80 tons. Only 4 tons of fuel are used per day as compared with 15 tons per day for a steamer. The Diesel-engined ship would require 120 tons of fuel for a thirty-day trip, as against 450 tons for a steamer, showing a net saving of 330 tons for the Diesel-engined ship, which, in addition to the 80 tons saved in the weight of machinery, makes a net deadweight saving of 410 tons in favor of the Diesel-engined ship. Additional savings would also be gained from the small bunker space required and in the reduction of the engine room staff.

Lumber and Passenger Steamer Columbia

The Harlan & Hollingsworth Corp., Wilmington, Del., completed on July 22 a steel lumber and passenger steamer for Wilson Bros. & Co., San Francisco, Cal.

The principal dimensions of the vessel are: Length over all 250 feet 11 inches, length between perpendiculars 243 feet 3 inches, beam, molded, 41 feet; depth, molded, 20 feet. The carrying capacity is 1,600,000 board feet of lumber at a load draft of 17 feet 6 inches. The gross tonnage is 1,923.84 and the net tonnage 1,188.

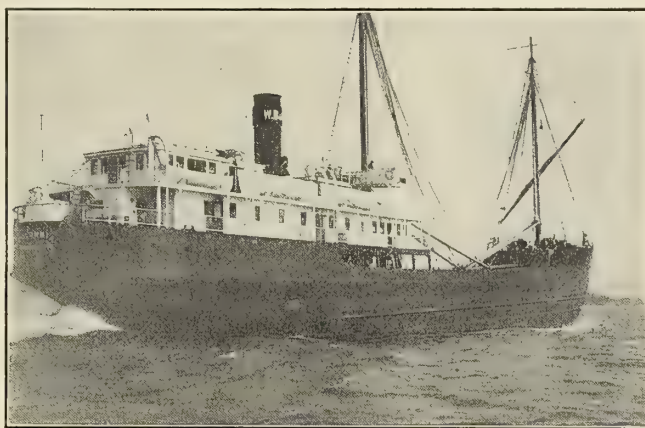
The vessel is built of steel, with one complete steel deck, a long poop and a forecastle deck. The scantlings are in excess of Lloyd's rules for ocean-going vessels.

The keel is of the flat keel type, $27\frac{1}{2}$ pounds to 20 pounds at ends. The center girder, which is oil-tight for the whole length, divides the double bottom into two separate tanks and is 42 inches by 8 inches amidships. The double angle connections at the top and bottom are 4 inches by 4 inches by 12.8 pounds.

The side frames above the tanktop are 6 inches by $3\frac{1}{2}$ inches by $3\frac{1}{2}$ inches by 15-pound channels, spaced 24-inch centers. Belt frames, 6 frame spaces apart, are fitted throughout the length of the ship and are of 12 inches by 3 inches by 3 inches by 25-pound channels. In the peaks the frames are 5 inches by $3\frac{1}{2}$ inches by 10.4-pound angles, 21-inch centers. The reverse frames are 3 inches by 3 inches by 7.2 pounds.

Two stringers run the length of the vessel under the main deck, consisting of 12 inches by 3 inches by 3 inches by 25-pound channels, fitted between each web frame and scored out for each ordinary frame. An angle 3 inches by 3 inches by 7.2 pounds runs inside of the ordinary frames on top of the channel. Diamond brackets are fitted on the face of the web frames connecting to the stringer channel. Between the main and forecastle decks the angle keelson inside the frames consists of double angles 5 inches by $3\frac{1}{2}$ inches by 8.5 pounds.

The main deck beams are 10 inches by $3\frac{1}{2}$ inches by $3\frac{1}{2}$ inches by 21.8-pound channels on every frame, except where



STEAMSHIP COLUMBIA

no deck load will be carried. The brackets are 30 inches by 24 inches by 20 pounds with flanged edge. The camber is 10 inches in 41 feet.

To ensure a free cargo space only pillars along the center line have been fitted, composed of single H-bars 39 pounds per foot.

The shell is worked in "in and out" strakes with joggled edge landings of outer strakes. The garboard strake is 20 pounds and 18 pounds at the ends, the bottom plating 18 pounds and 16 pounds, the bilge plating 20 pounds and 16 pounds, side plating 20 pounds and 16 pounds, sheerstrake 25 pounds and 21 pounds, and the poop and forecastle 15 pounds. Below the waterline the plating aft maintains the amidships thickness.

The main deck plating is of 14 pounds throughout, except the stringer, which is 48 inches by 20 pounds to 16 pounds at the ends. The stringer angles are 4 inches by 4 inches by 12.8 pounds.

All watertight bulkheads are plated vertically with 13-pound plates, the stiffeners being 6 inches by 3 inches by 3 inches by 15-pound channels, spaced 30-inch centers and at the forepeak 24-inch centers. The brackets at the top and bottom are of 15-pound plates, connection to shell being by double $3\frac{1}{2}$ inches by $3\frac{1}{2}$ inches by 8.5-pound angles.

There are three longitudinals on each side of the keel in the double bottom, consisting of 13-pound intercostal plates flanged at the top and bottom, the floor connection being 3 inches by 3 inches by 6.1-pound clips. The intercostals in the engine and boiler rooms are of 16-pound plates.

The tanktop plating is 14 pounds throughout, except under the engine and boiler rooms, where it is 16 pounds.

The vessel has one triple-expansion, surface-condensing engine with cylinders 19 inches, 30 inches, 50 inches diameter by 36-inch stroke. The valve gear is of the Stephenson link motion type. The air pump, which is bolted to the back of the condenser, is worked from the crosshead of the intermediate cylinder. The electric generating plant consists of two sets of generators working at 115 volts, one of 15 kilowatts and the other of 7 kilowatts capacity, made by the General Electric Co. Each is driven by a single steam engine using 100 pounds steam pressure. An ice-making plant of one ton capacity per 24 hours, of the direct-expansion type, has been supplied by the Union Iron Works, San Francisco. There is also a 15-gallon water cooler. The two boilers of the cylindrical return-tube type, each 12 feet diameter by 11 feet 6 inches length, are constructed for 180 pounds working pressure. Each contains three furnaces 36 inches inside diameter, connected to one common combustion chamber. The tubes, 222 in number, are 3 inches diameter by 8 feet effective length. The oil-fuel burners are of Union Iron Works make, working with pressure, atomizing without steam or compressed air. One burner is fitted to each furnace.

The vessel has a Marconi wireless outfit and electric lighting throughout. A searchlight, 14 inches diameter, of the General Electric type, is installed on top of the pilot house, with inside control.

Four powerful hoisting engines, of Union Iron Works make, are mounted on special platforms.

There are four metallic life boats 23 feet long, also one 16-foot square stern working boat, all located on the bridge deck.

The main house, located on the poop deck, also the pilot house, officers' and after house on the boat deck, are built of pine, with sheathing tongued and grooved, and finished to resemble steel work. The boat deck has pine carlins 4 inches by 2¼ inches, spaced 24 inches, the decking consisting of 1½-inch tongued and grooved pine, with a margin strip around. Where exposed there is a double layer of felt on the deck, finished with canvas on top.

The dining saloon is paneled in white pine, as is also the lounge. The smoking room has walls stayed with "V" jointed tongued and grooved quartered oak. The total number of first-class passengers in staterooms is 54, of which the dining room can accommodate 36 at one sitting.

The vessel is equipped with two cast steel stockless anchors, of 3,500 pounds each; also one kedge anchor of 600 pounds.

There is a Hyde type brake windlass, with a double 8 inches by 8 inches engine on the forecastle. The steam steering gear is aft on the main deck; also alongside this is a 6 inches by 8 inches double engine operating a Hyde steam gipsy on the poop deck above. A No. 3 Providence automatic steam towing engine is located in a steel house on the poop deck aft. It has 14 inches by 14 inches cylinders and handles 1¾ inches diameter steel wire towing hawsers.

The vessel is schooner-rigged, carries a cross-yard and square sail on the foremast and the usual other sails. Each mast carries two wooden booms. Chain plates, turnbuckles and lashings of substantial design are supplied to secure a considerable deck cargo of lumber.

At the launch the vessel was named *Columbia*, her port of registry being San Francisco. On trial, with ballast tanks full, the vessel made a mean speed of 11 knots and developed 1,200 indicated horsepower. She is expected to make about 10 knots loaded in service.

The vessel, chartered by Bates & Cheseborough, sailed from Philadelphia with a full cargo in charge of Captain C. E. Allen. She is going out using oil fuel, and is expected to make a call at a South American port to refill her tanks with oil. The chief engineer is Mr. P. Concannon.

Two Notable Oil Engined Fishing Schooners

On the Pacific Coast of Canada, the long, narrow reaches of the inside route from Seattle and Vancouver to the halibut grounds off the coast of Alaska have made the sails of the fishing schooners employed in the halibut industry an almost useless part of their equipment during the major portion of their trips. To overcome this difficulty, many of these boats are equipped with auxiliary power; but it has remained with the New England Fish Company to take the longest step forward in the industry. This firm's headquarters are at Boston, but they have important offices in New York, Seattle, Vancouver and Ketchikan, Alaska.

They are now having built at the yards of Arthur D. Story, in Essex and Gloucester, Mass., two sister schooners of a modified knock-about type, 126 feet length over all; 102 feet length waterline; 24½ feet breadth waterline; with a mean draft of 10 feet, to be powered with two 100-horsepower Blanchard oil engines, operating twin screws and developing a speed under power alone of about 10½ miles an hour. They will have plain pole masts with no top masts, and the sail area will be cut down to 4,500 square feet, less than one-half that with which boats of this size would be normally equipped. Briefly, the sails are to be used only as auxiliaries to the engines, which are a late development by the Blanchard Machine Company, under the direction of Wolcott Remington. They are of particular interest in that they will use for fuel a low-grade, asphaltum-base oil that is put out by the Standard Oil Company on the Pacific Coast as Star Fuel Oil. It costs only a dollar (4/2) a barrel in Seattle, and its high-flash point makes it as safe as coal.

It is planned to launch the two schooners early in October; and, after the engines have been installed and the rigging and outfitting completed, they will proceed to Seattle via Cape Horn, arriving there in time for the early spring work.

The schooners were designed by Thos. F. McManus, of Boston. He has been prominently connected with the New England fishing industry for fourteen years, thirteen years as an active participant and the remainder as a designer of fishing schooners, and in that time has built and designed over three hundred vessels.

The original type of fishing schooner was shallow draft with long bowsprit and jib boom and very long main boom, giving it a long sail base line extending far outboard, making the work of handling sails in heavy weather exceedingly dangerous. In fact, the chance of wreck in storms was one of the most serious that fishermen of those days took; but now all this has been changed, and the production by Mr. McManus, several years ago, of the knock-about type, with its deep and sharp hull lines, short sail base and eliminated bowsprit, have made these boats safe and easy to handle in heavy seas. There is less pitching and great saving of wear and tear on the rigging; no bobstays to leak; no bowsprit to loosen; and, with practically no overboard work for the men to do in handling sails, they now fear only fog, collision and shore.

On the Pacific Coast the need for this step has been imperative, and the results achieved by these vessels will be watched with interest, not alone there, but on the Atlantic Coast as well, for the increasing need of power is being strongly felt by the Boston and Gloucester fishermen, as a delay of a few hours in landing their fish at T wharf may mean a decrease of hundreds of dollars in the prices they obtain for their catch.

The Bureau of Navigation reports 161 sailing, steam and unriggered vessels of 21,139 gross tons built in the United States and officially numbered during the month of August, 1912. Three of these, aggregating 10,101 gross tons, were steel steamships built on the Atlantic coast.

Fire Protection of Pier Sheds

BY SIDNEY G. KOON, M. M. E.

Probably the most terrible disaster on a pier or in a pier shed was that which, in 1900, destroyed the American terminal of the North German Lloyd Steamship Company in Hoboken, N. J. This fire started, probably by spontaneous combustion, in the midst of a pile of cotton bales on the unprotected pier, and swept like wildfire from one end of the great structure to the other, a distance of several hundred feet. Three transatlantic liners (*Bremen*, *Main* and *Saale*) were so badly damaged as to necessitate almost complete rebuilding, while the express steamer *Kaiser Wilhelm der Grosse* was badly scorched. About 300 lives were lost, mainly because of the extremely rapid spread of fire and the fact that the fire was between the crowd of passengers and employees and the shore, where safety lay.

For the use of transatlantic liners and other vessels, where it is necessary to handle large quantities of freight and bag-

The problem thus becomes one of dealing with a situation, the salient features of which involve an enormous open space without fire breaks of any kind, and either a wooden, and hence combustible, construction of pier and shed, or where circumstances have made it imperative a fireproof pier and shed, filled more or less closely from one end to the other with inflammable material. The problem is further complicated by reason of the fact that numerous openings around the sides give free access to the more or less constant breezes to be found around the water, and which would inevitably help to fan into destructive size any incipient fire which might start.

The ordinary means adopted for fighting fires in pier sheds depends upon extinguishing, usually after the fire has gained considerable headway, by means of streams of water from nozzles connected to hose of varying size, some of it supplied

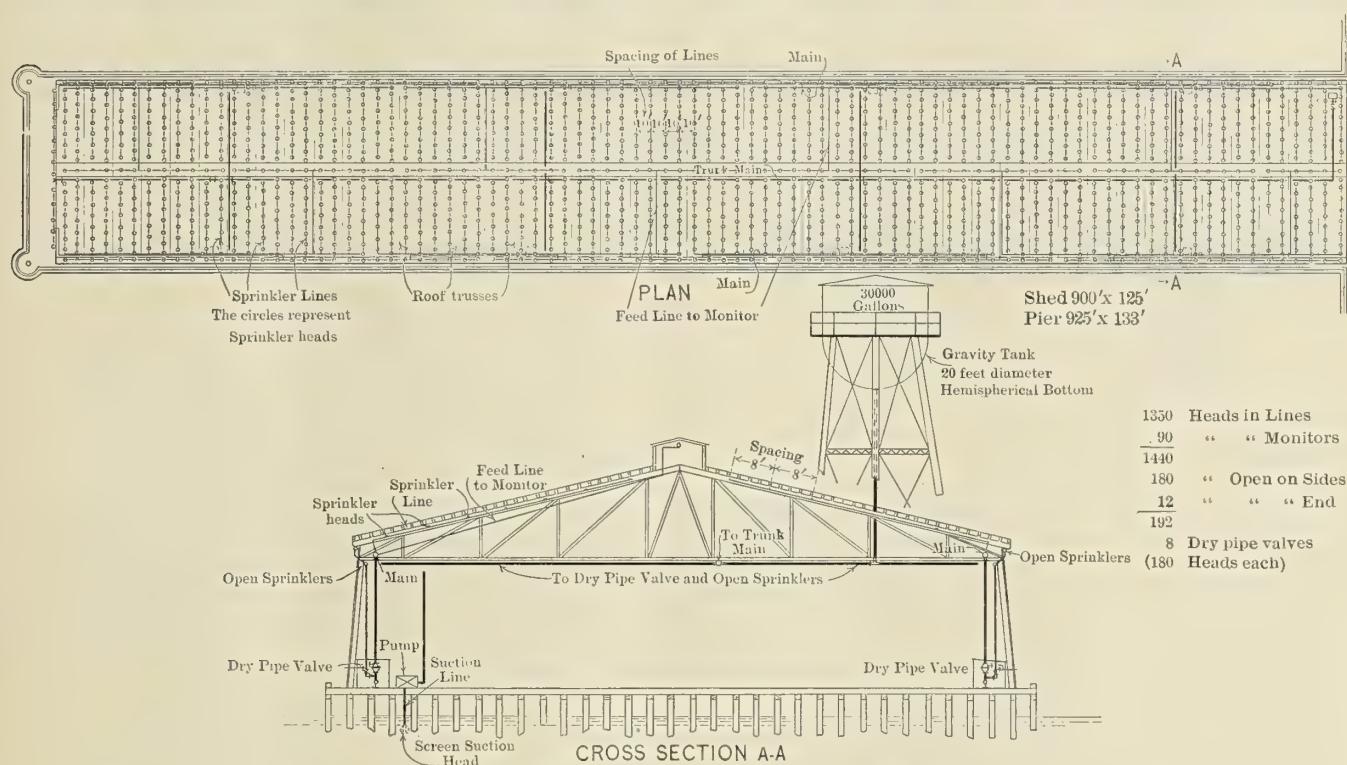


FIG. 1.—LAYOUT OF SPRINKLER EQUIPMENT FOR A PIER SHED

gage with dispatch, and where large numbers of people (passengers, crew and porters or stevedores) are moving back and forth, it is wholly impracticable to divide the space into relatively small compartments for the purpose of retarding the spread of fire which might start at any point. In the cases of the larger and more modern of these pier sheds we find a virtually unbroken area, measuring from 600 to 900 feet in length and from 100 to 130 feet in width. Small temporary wooden structures, such as shipping offices, etc., sometimes subdivide the area in slight measure, so far as general appearance goes; but as such structures are of the most combustible material, it is seen that from the fire protection standpoint they are of absolutely no avail. It is quite usual to find a ship on either side of this shed, both vessels engaged in loading and discharging miscellaneous cargo of the most heterogeneous type, and frequently of the most inflammable kind. The cotton bales mentioned in our opening paragraph indicate the truth of this last statement.

with water pressure from the pumping outfits on the ships themselves, some from standpipe pressure on the pier, some from city fire departments, either with steam fire engine service or with high-pressure main service, while in the most favored cases a fourth source of stream is a fire-boat, now being so highly developed in cities where water commerce is a large factor in the life of the community. If any one of these could be directed at the seat of the disturbance within the first 60 or 90 seconds from the beginning of the fire, there would very rarely be anything sufficiently serious to call for newspaper comment. Usually, however, the efforts put forth during the first five minutes of the life of the blaze are almost valueless so far as well-directed operation is concerned. Excitement, lack of knowledge of location of apparatus or of methods of operating valves, and many other similar contributing features, make the problem most difficult. In this respect this sort of a fire is no different from any other, but these points are here brought out for the purpose of showing

the contrast presented by automatic equipment of the type later described.

For the ordinary fire protection of buildings, whether manufacturing, mercantile, or office, numerous devices have been perfected and are on the market, practically all of which have value, but not by any means in equal degree. These include such items as automatic fire doors and shutters, closing when released by a fusible link whenever a fire raises a temperature above a certain predetermined point; standpipes with coils of hose attached; portable fire extinguishers depending usually upon the generation of some form of carbonic gas; and, most important of all, automatic sprinklers. The fire doors and shutters are analogous to wired glass windows in that they form a barrier acting to greatly retard the spread of fire. It is obvious that they would have no place on a pier shed, because it is impracticable to subdivide the space. The standpipe and hose and the portable extinguishers are already in use and have been responsible for putting out a great many fires. In both cases, however, it is necessary that men be at hand familiar with their use

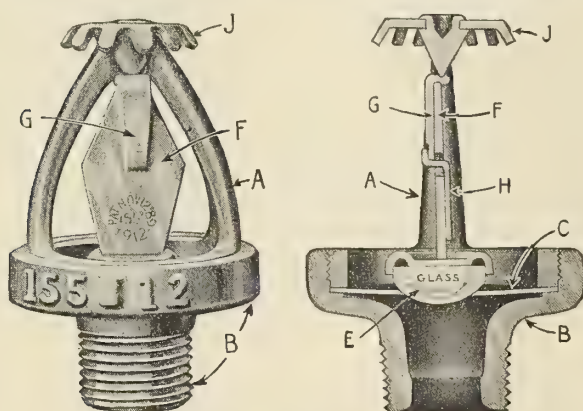


FIG. 2.—GRINNELL AUTOMATIC SPRINKLER HEAD

and able to direct the stream upon the fire before it has begun to attain destructive size. In case the fire occurs at night, it may gain very considerable headway before being discovered, and this sort of equipment will thus be completely nullified.

The automatic sprinkler, however, is a device which does not require the presence of any human being. It has through years of development been made so sensitive as to bring the proportion of failures down below one percent. It will operate under conditions of heat, smoke, darkness and other disturbing factors just as certainly and effectively as under the most favorable circumstances. Repeated tests have shown that sprinklers operate usually within thirty to sixty seconds of the first appearance of fire. Thirty percent of all fires under these sprinklers, as reported during the past fifteen years' experience by the National Fire Protection Association, have been put out or completely held in check by a single sprinkler head, while nearly 60 percent have been similarly controlled by not more than 3 heads.

For the ordinary fire hazard these sprinklers are arranged so that one head covers a floor area of from 80 to 100 square feet. The water supply is usually provided in duplicate, in order to make certain that at no time shall the system be without adequate water pressure and the building without protection. Where city water is available under good pressure this forms usually one of the dual sources. The other may be supplied by an elevated tank furnishing a pressure due to its static head; a pressure tank two-thirds full of water and one-third with air at considerable pressure, which will supply a moderate number of sprinklers for a few minutes; or an Underwriters' fire pump operated by either steam or electricity, and designed to deliver a maximum of from 500 to 1,500 gallons of water per minute.

The water is led into the building through a pipe large enough to supply a flow for the entire equipment. It is then carried in one or more risers up through the several floors, if there are more than one, and mains are taken off below the ceiling of each floor. In the case of the usual pier shed these mains would be taken off on each side and run parallel to side of shed, a little below the roof. From the mains are run branch lines, following the slope of the roof, each of which carries a series of sprinkler heads at intervals of about 8 feet, these lines being themselves about 10 feet apart. All of the piping is reduced gradually in size from the riser to the uttermost sprinkler, and it is all arranged with a slight drainage from that uttermost sprinkler back through the several subdivisions to the riser, in order that the system may be completely emptied of water when necessary. The sprinkler lines, parallel to the line of the roof and distant about 9 inches from it, carry the heads 4 or 5 inches below the roof and have natural drainage. In addition to the sprinklers throughout the open space, it would be necessary to provide sprinklers under the ceilings of all enclosed spaces, such as freight offices, waiting rooms, etc., the arrangement of lines and sprinkler heads being as before.

Each head consists of a pipe fitting, with a one-half inch opening for the passage of water. This opening is kept closed by a valve held rigidly in position by a strut, which is itself held together by fusible solder. The design of the strut is such that the physical strain upon it is well within its capacity. The solder is carefully prepared for a predetermined fusing point, usually about 155 degrees F. As soon as the temperature caused by the rising heat of the fire reaches this temperature at the location of the head, the solder fuses and the valve and strut are forced by the water pressure out into the room, leaving an unobstructed passage for a stream of water under full pressure. This stream, striking a deflector at the top of the head, is scattered in all directions in the form of a hard-driven rain. As all fires, except those from explosions, are very small at the start, it is evident that unless such a sprinkler equipment is handicapped by either obstruction to distribution of water, or in some other preventable way, a fire under the system is bound to be drowned automatically and very quickly. The action of the sprinkler in thus operating to put out the fire by means of the heat from the fire itself is such as to virtually make the fire commit suicide.

A typical and actual layout for a sprinkler equipment for this service is shown in sketches which, with the foregoing general explanation of the system, will be self-explanatory. One sketch shows the location of a fire pump upon the floor and of a tank on a tower upon the roof of the structure. Means would, of course, have to be taken to prevent this tank from freezing; this could be done either by a steam coil, or, in some cases, by an electric heater. In the same way, it would be necessary to either keep the temperature in the pier shed above 32 degrees F. or arrange for other means to prevent freezing up of the apparatus, and consequent nullification of its usefulness.

Highly developed apparatus for the purpose just mentioned takes the form of what is known as a dry-pipe valve, in which the water is held back in either the city main or the supply from the tank or fire pump. Eight dry-pipe valves, each controlling 180 sprinkler heads, were used in the layout illustrated. The sprinkler lines, mains and risers are filled with compressed air at a moderate pressure. The opening of a sprinkler head quickly releases this pressure. This at once operates the dry-pipe valve and allows the water which has been held back of this point to rush into the system, after which the operation is precisely the same as with the more ordinary wet-pipe system.

For protecting the outside of a shed, and material passing between the shed and the ship, open sprinkler heads are placed

along under the eaves at intervals of about 10 feet. These are not automatic. Water is turned into them whenever a fire threatens the outside of the shed, and as they are arranged in sections of about ten heads each along the length of the shed, it is obvious that protection may be extended just so far as may be necessary. In the open air the action of an automatic sprinkler at this point would be very uncertain because the heat of the fire would not in any way be confined, and it might get considerable headway before causing any action. That is why these outside sprinklers are controlled by hand.

While not going into the details of design, construction, and operation of a sprinkler system, it will be of interest to describe the head, upon the efficient, automatic working of which the value of the system depends. Two views of the head made and installed by the General Fire Extinguisher Co., Providence, R. I., are given, one being a section. As will be noted, *B* is the body or fitting which screws onto the tee in the line pipe. *A* is the yoke or frame carrying the deflector *J* and itself screwing into the body. Between *A* and *B* is a flexible diaphragm *C* with a half-inch hole in the center. Into this hole fits a hemispherical glass valve *E*. The valve is held in position by a small metal cap and a strut of three pieces, *F*, *G*, and *H*. The three pieces of the strut are joined by soft solder designed to fuse at 155 degrees F. As soon as the temperature reaches this point, the disruption of the strut begins, and ultimately takes the form of a rocking motion, one part about the other. During this movement, the flexible diaphragm, with the full water pressure under its entire area, holds tightly against the glass valve until as *F*, *G*, and *H* finally part, both the valve and strut are thrown out into the room and the solid stream of water, impinging upon the deflector, is scattered in all directions. After the sprinkler system has extinguished the fire, the one or more heads which have operated are removed from the system and new heads containing the strut in place are substituted. The water is then turned on again, and the system is ready for the next attack of its hated enemy.

Among the great advantages derived from the use of automatic sprinkler protection of this sort is a very large reduction in insurance premiums, amounting often to more than 50 percent. In the case of the ordinary building this reduction is sufficient to pay for the entire equipment within a period which averages about five years. When it comes to a question of pier sheds, however, the problem is considerably complicated by the fact that the piers are usually owned by the municipality and occupied by a tenant. The entire contents are owned by the tenant; but as the term of lease is ordinarily short, the tenant does not often feel justified in installing an equipment which would mean a considerable initial outlay, even though this outlay might be more than covered by his saving in insurance. For this reason very few piers have been fitted with automatic sprinklers, although a number of estimates have been made from time to time. In the case illustrated, the total cost of the installation was estimated at about \$19,000 (£3,900).

Another great difficulty in connection with the fitting of these pier sheds arises from the question of water supplies. The sheds are so exposed, both inside and out, as to make freezing in the winter a matter of concern, and it is an engineering feat of considerable intricacy to arrange an equipment in this type of structure in which freezing will be adequately cared for. The thing can be done, however, and there is not the slightest possibility of doubt that the results would be thoroughly satisfactory and much more than justify the outlay. The financial loss sustained in the one fire which we have mentioned would have equipped all of the Hudson River piers of New York City with automatic sprinklers.

Panama Canal Act

The Panama Canal Act passed by Congress and signed by President Taft is a comprehensive measure providing adequately for the opening, maintenance, protection and operation of the Panama Canal and the sanitation and government of the Canal Zone. The act comprises eleven sections in all, only three of which, however, have direct bearing on marine affairs. These three deal with the Panama Canal tolls, the regulation of commerce, and the regulation of wireless communication, the provision of dry docks, repair shops, yards, docks, wharves, warehouses, storehouses and other necessary facilities for providing coal and other materials, labor, repairs and supplies for United States war vessels, and, incidentally, for supplying such facilities at a reasonable price for all shipping passing through the canal. The full text of these sections is as follows:

Section 5. That the President is hereby authorized to prescribe, and from time to time change, the tolls that shall be levied by the Government of the United States for the use of the Panama Canal: *Provided*, That no tolls, when prescribed as above, shall be changed, unless six months' notice thereof shall have been given by the President by proclamation. No tolls shall be levied upon vessels engaged in the coastwise trade of the United States. That section forty-one hundred and thirty-two of the Revised Statutes is hereby amended to read as follows:

"Section 4132. Vessels built within the United States and belonging wholly to citizens thereof, and vessels which may be captured in war by citizens of the United States and lawfully condemned as prize, or which may be adjudged to be forfeited for a breach of the laws of the United States, and sea-going vessels, whether of steam or sail, which have been certified by the Steamboat Inspection Service as safe to carry dry and perishable cargo, not more than five years old at the time they apply for registry, wherever built, which are to engage only in trade with foreign countries or with the Philippine Islands and the islands of Guam and Tutuila, being wholly owned by citizens of the United States or corporations organized and chartered under the laws of the United States, or of any State thereof, the president and managing directors of which shall be citizens of the United States, and no others, may be registered as directed in this title. Foreign-built vessels registered pursuant to this act shall not engage in the coastwise trade: *Provided*, That a foreign-built yacht, pleasure boat or vessel, not used or intended to be used for trade, admitted to American registry pursuant to this section, shall not be exempt from the collection of *ad valorem* duty provided in section thirty-seven of the act approved August fifth, nineteen hundred and nine, entitled 'An Act to provide revenue, equalize duties, and encourage the industries of the United States, and for other purposes.' That all materials of foreign production which may be necessary for the construction or repair of vessels built in the United States, and all such materials necessary for the building or repair of their machinery, and all articles necessary for their outfit and equipment may be imported into the United States free of duty under such regulations as the Secretary of the Treasury may prescribe: *Provided, further*, That such vessels so admitted under the provisions of this section may contract with the Postmaster-General, under the act of March third, eighteen hundred and ninety-one, entitled 'An act to provide for ocean mail service between the United States and foreign ports, and to promote commerce, so long as such vessels shall in all respects comply with the provisions and requirements of said act. Tolls may be based upon gross or net registered tonnage, displacement tonnage, or otherwise, and may be based on one form of tonnage, or otherwise, and may be based on one form of tonnage for warships and another for ships of commerce. The rate of tolls may be lower upon vessels in ballast than

upon vessels carrying passenger or cargo. When based upon net registered tonnage for ships of commerce the tolls shall not exceed one dollar and twenty-five cents per net registered ton, nor be less, other than for vessels of the United States and its citizens, than the estimated proportionate cost of the actual maintenance and operation of the Canal, subject, however, to the provisions of article nineteen of the convention between the United States and the Republic of Panama, entered into November eighteenth, nineteen hundred and three. If the tolls shall not be based upon net registered tonnage, they shall not exceed the equivalent of one dollar and twenty-five cents per net registered ton as nearly as the same may be determined, nor be less than the equivalent of seventy-five cents per net registered ton. The toll for each passenger shall not be more than one dollar and fifty cents. The President is authorized to make, and from time to time amend, regulations governing the operation of the Panama Canal, and the passage and control of vessels through the same or any part thereof, including the locks and approaches thereto, and all rules and regulations affecting pilots and pilotage in the Canal or the approaches thereto through the adjacent waters."

Such regulations shall provide for prompt adjustment by agreement and immediate payment of claims for damages which may arise from injury to vessels, cargo or passengers from the passing of vessels through the locks under the control of those operating them under such rules and regulations. In case of disagreement, suit may be brought in the District Court of the Canal Zone against the Governor of the Panama Canal. The hearing and disposition of such cases shall be expedited, and the judgment shall be immediately paid out of any moneys appropriated or allotted for Canal operation.

The President shall provide a method for the determination and adjustment of all claims arising out of personal injuries to employees thereafter occurring while directly engaged in actual work in connection with the construction, maintenance, operation or sanitation of the Canal or of the Panama Railroad, or of any auxiliary canals, locks, or other works necessary and convenient for the construction, maintenance, operation, or sanitation of the Canal, whether such injuries result in death or not, and prescribe a schedule of compensation therefor, and may revise and modify such method and schedule at any time; and such claims to the extent they shall be allowed on such adjustment, if allowed at all, shall be paid out of the moneys hereafter appropriated for that purpose or out of the funds of the Panama Railroad Company, if said company was responsible for said injury, as the case may require. And after such method and schedule shall be provided by the President the provisions of the act entitled, "An Act granting to certain employees of the United States the right to receive from it compensation for injuries sustained in the course of their employment," approved May thirtieth, nineteen hundred and eight, and of the act entitled "An Act relating to injured employees on the Isthmian Canal," approved February twenty-fourth, nineteen hundred and nine, shall not apply to personal injuries thereafter received and claims for which are subject to determination and adjustment as provided in this section.

Section 6. That the President is authorized to cause to be erected, maintained and operated, subject to the International Convention and the Act of Congress to regulate radio communication, at suitable places along the Panama Canal and the coast adjacent to its two terminals, in connection with the operation of said Canal, such wireless telegraphic installations as he may deem necessary for the operation, maintenance, sanitation and protection of said Canal, and for other purposes. If it is found necessary to locate such installations upon territory of the Republic of Panama, the President is authorized to make such agreement with said Government as may be necessary, and also to provide for the acceptance and

transmission, by said system, of all private and commercial messages, and those of the Government of Panama, on such terms and for such tolls as the President may prescribe: *Provided*, That the messages of the Government of the United States and the departments thereof, and the management of the Panama Canal, shall always be given precedence over all other messages. The President is also authorized, in his discretion, to enter into such operating agreements or leases with any private wireless company or companies as may best insure freedom from interference with the wireless telegraphic installations established by the United States. The President is also authorized to establish, maintain, and operate, through the Panama Railroad Company, or otherwise, dry docks, repair shops, yards, docks, wharves, warehouses, storehouses and other necessary facilities and appurtenances for the purpose of providing coal and other materials, labor, repairs and supplies for vessels of the Government of the United States, and, incidentally, for supplying such at reasonable prices to passing vessels, in accordance with appropriations hereby authorized to be made from time to time by Congress as a part of the maintenance and operation of the said Canal. Moneys received from the conduct of said business may be expended and reinvested for such purposes without being covered into the Treasury of the United States; and such moneys are hereby appropriated for such purposes, but all deposits of such funds shall be subject to the provisions of existing law relating to the deposit of other public funds of the United States, and any net profits accruing from such business shall annually be covered into the Treasury of the United States. Monthly reports of such receipts and expenditures shall be made to the President by the persons in charge, and annual reports shall be made to the Congress.

Section 11. That section five of the act to regulate commerce, approved February fourth, eighteen hundred and eighty-seven, as heretofore amended, is hereby amended by adding thereto a new paragraph at the end thereof, as follows:

"From and after the first day of July, nineteen hundred and fourteen, it shall be unlawful for any railroad company or other common carrier subject to the act to regulate commerce to own, lease, operate, control, or have any interest whatsoever (by stock ownership or otherwise, either directly, indirectly, through any holding company, or by stockholders or directors in common, or in any other manner) in any common carrier by water operated through the Panama Canal or elsewhere with which said railroad or other carrier aforesaid does or may compete for traffic, or any vessel carrying freight or passengers upon said water route or elsewhere; and in case of the violation of this provision each day in which such violation continues shall be deemed a separate offense."

Jurisdiction is hereby conferred on the Inter-State Commerce Commission to determine questions of fact as to the competition, or possibility of competition, after full hearing, on the application of any railroad company or other carrier. Such application may be filed for the purpose of determining whether any existing service is in violation of this section and pray for an order permitting the continuance of any vessel or vessels already in operation, or for the purpose of asking an order to install new service not in conflict with the provisions of this paragraph. The Commission may on its own motion or the application of any shipper institute proceedings to inquire into the operation of any vessel in use by any railroad or other carrier which has not applied to the Commission and had the question of competition or the possibility of competition determined as herein provided. In all such cases the order of said Commission shall be final. If the Inter-State Commerce Commission shall be of the opinion that any such existing specified service by water other than through the Panama Canal is being operated in the interest of the public, and is of

advantage to the convenience and commerce of the people, and that such extension will neither exclude, prevent, nor reduce competition on the route by water under consideration, the Inter-State Commerce Commission may, by order, extend the time during which such service by water may continue to be operated beyond July first, nineteen hundred and fourteen. In every case of such extension the rates, schedules and practices of such water carrier shall be filed with the Inter-State Commerce Commission, and shall be subject to the act to regulate commerce and all amendments thereto in the same manner and to the same extent as is the railroad or other common carrier controlling such water carrier or interested in any manner in its operation: *Provided*, Any application for extension under the terms of this provision filed with the Inter-State Commerce Commission prior to July first, nineteen hundred and fourteen, but for any reason not heard and disposed of before said date may be considered and granted thereafter.

No vessel permitted to engage in the coastwise or foreign trade of the United States shall be permitted to enter or pass through said Canal if such ship is owned, chartered, operated, or controlled by any person or company which is doing business in violation of the provisions of the act of Congress approved July second, eighteen hundred and ninety, entitled "An Act to protect trade and commerce against unlawful restraints and monopolies," or the provisions of sections seventy-three to seventy-seven, both inclusive, of an act approved August twenty-seventh, eighteen hundred and ninety-four, entitled "An Act to reduce taxation, to provide revenue for the Government, and for other purposes," or the provisions of any other act of Congress amending or supplementing the said act of July second, eighteen hundred and ninety, commonly known as the Sherman Anti-Trust Act, and amendments thereto, or said sections of the act of August twenty-seventh, eighteen hundred and ninety-four. The question of fact may be determined by the judgment of any court of the United States of competent jurisdiction in any cause pending before it to which the owners or operators of such ship are parties. Suit may be brought by any shipper or by the Attorney-General of the United States.

That section six of said act to regulate commerce, as heretofore amended, is hereby amended by adding a new paragraph at the end thereof, as follows:

"When property may be or is transported from point to point in the United States by rail and water through the Panama Canal or otherwise, the transportation being by a common carrier or carriers, and not entirely within the limits of a single State, the Inter-State Commerce Commission shall have jurisdiction of such transportation and of the carriers, both by rail and by water, which may or do engage in the same, in the following particulars, in addition to the jurisdiction given by the act to regulate commerce, as amended June eighteenth, nineteen hundred and ten:

"(a) To establish physical connection between the lines of the rail carrier and the dock of the water carrier by directing the rail carrier to make suitable connection between its line and a track or tracks which have been constructed from the dock to the limits of its right of way, or by directing either or both the rail and water carrier, individually or in connection with one another, to construct and connect with the lines of the rail carrier a spur track or tracks to the dock. This provision shall only apply where such connection is reasonably practicable, can be made with safety to the public, and where the amount of business to be handled is sufficient to justify the outlay.

"The Commission shall have full authority to determine the terms and conditions upon which these connecting tracks, when constructed, shall be operated, and it may, either in the construction or the operation of such tracks, determine

what sum shall be paid to or by either carrier. The provisions of this paragraph shall extend to cases where the dock is owned by other parties than the carrier involved.

"(b) To establish through routes and maximum joint rates between and over such rail and water lines, and to determine all the terms and conditions under which such lines shall be operated in the handling of the traffic embraced.

"(c) To establish maximum proportional rates by rail to and from the ports to which the traffic is brought, or from which it is taken by the water carrier, and to determine to what traffic and in connection with what vessels and upon what terms and conditions such rates shall apply. By proportional rates are meant those which differ from the corresponding local rates to and from the port, and which apply only to traffic which has been brought to the port or is carried from the port by a common carrier by water.

"(d) If any rail carrier subject to the act to regulate commerce enters into arrangements with any water carrier operating from a port in the United States to a foreign country, through the Panama Canal or otherwise, for the handling of through business between interior points of the United States and such foreign country, the Inter-State Commerce Commission may require such railway to enter into similar arrangements with any or all other lines of steamships operating from said port to the same foreign country."

The orders of the Inter-State Commerce Commission relating to this section shall only be made upon formal complaint or in proceedings instituted by the Commission of its own motion and after full hearing. The orders provided for in the two amendments to the act to regulate commerce enacted in this section shall be served in the same manner and enforced by the same penalties and proceedings as are the orders of the Commission made under the provisions of section fifteen of the act to regulate commerce, as amended June eighteenth, nineteen hundred and ten, and they may be conditioned for the payment of any sum or the giving of security for the payment of any sum or the discharge of any obligation which may be required by the terms of said order.

Large Floating Docks

Owing to the recent departure of two large floating docks from shipyards at Barrow and Birkenhead for Montreal and Portsmouth respectively, there has been aroused a good deal of public interest in floating docks. There has, however, been some confusion as to the size of these docks, one of which has been described as being the largest in the world, which is not correct. The new floating dock at Portsmouth for the Admiralty is of just the same size and design as that built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., Wallsend, for the British Admiralty, and sent to the River Medway this summer. These twin floating docks, designed to lift battleships up to 32,000 tons displacement, are the largest yet built or owned in Great Britain, but still larger are the 40,000-ton floating dock owned by the German Government at Kiel and the 35,000-ton dock belonging to Messrs. Blohm & Voss at Hamburg.

PARTICULARS OF SOME OF THE LARGEST FLOATING DOCKS IN THE WORLD.

Dock.	Lifting Capacity. Tons.	Length. Ft.	Clear Width. Ft.	Depth Over Keel Blocks. Ft.	Owners.
Kiel	40,000	656	154	35¼	German Govt.
Hamburg	35,000	720	108½	33	Blohm & Voss.
Medway	32,000	680	113	36	British Admiralty
Portsmouth	32,000	680	113	36	British Admiralty
Montreal	25,000	600	100	27½	Can. Vickers, Ltd.
Hamburg	25,000	525¾	108½	33	Vulcan Co.
Pola	22,500	584¾	111½	37	Austro-Hung. Govt.
Rio de Janeiro	22,000	550	100	30	Brazilian Govt.
Hamburg	20,000	511¼	97	26	Reiherstieg Co.



FIG. 1.—MOTOR SHIP MONTE PENEDO

Sulzer Diesel-Engined Ship for New York-Rio Service

BY J. RENDELL WILSON

During the past two years we have repeatedly declared that the large motor ship has come to stay, and our statements have been borne out by the success of such Diesel craft as *Selandia*, *Christian X.*, *Vulcanus*, *Toiler* and the numerous Russian vessels.

Quite a number of shipping concerns of repute have ordered Diesel craft, consequently the various marine engineers and shipbuilders in England and on the Continent have as much work of this nature as they can undertake. That the heavy oil engine is slowly ousting steam machinery from its

proud position may be gathered from the fact that Messrs. Burmeister & Wain, builders of *Selandia* and *Christian X.*, have nine more large motor ships under construction to one steam vessel at their Copenhagen yards.

On Aug. 24 the trials took place at Hamburg of the Hamburg-South America Line's new motor ship *Monte Penedo*, a twin-screw vessel of 6,500 tons deadweight for the New York-Rio service. One of the most interesting features about her is that her Sulzer machinery is of the two-stroke type, so she is one of the first large ocean-going vessels to be driven by

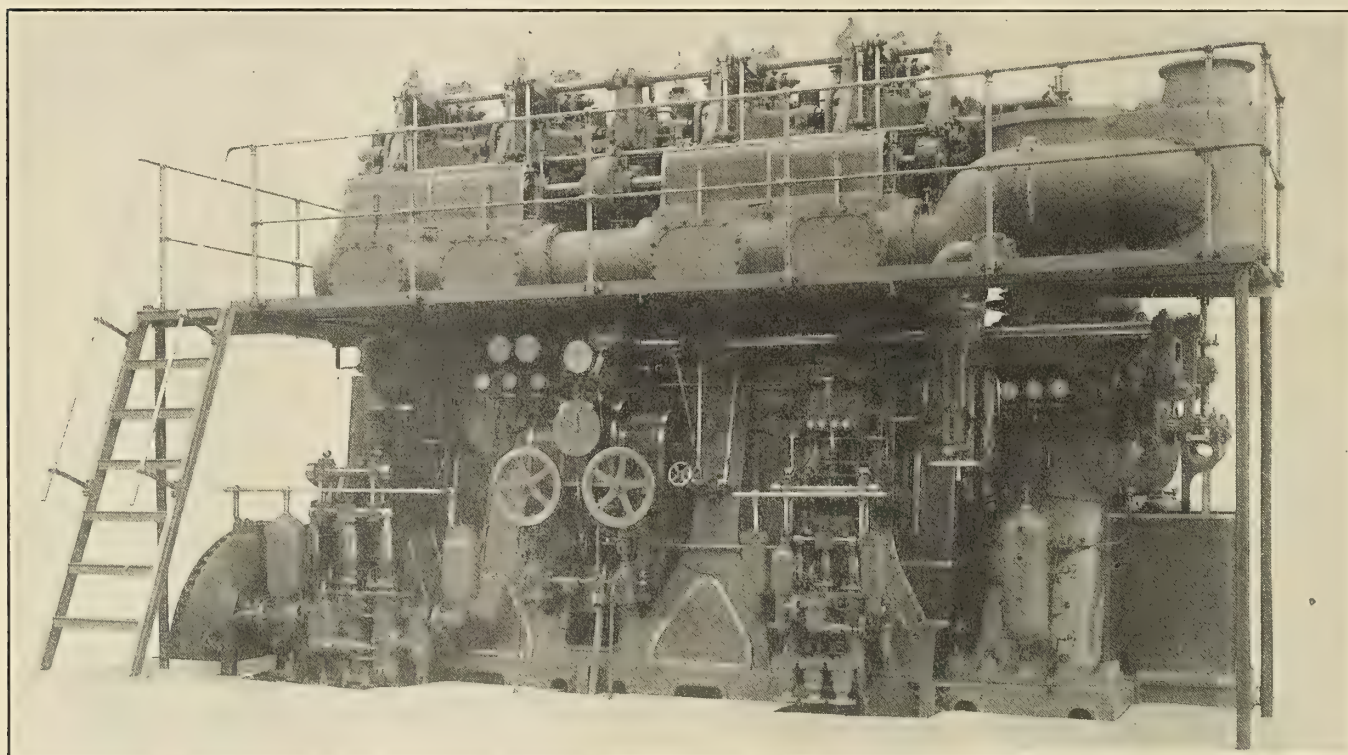


FIG. 2.—SULZER DIESEL ENGINE FOR THE MONTE PENEDO

this class of machinery, most all of the existing big motor craft having four-cycle Diesel engines installed. Thus her working will be closely followed by ship owners.

Monte Penedo is 350 feet in length by 50 feet beam, and has a molded depth of 27 feet. By dispensing with stokers there is a reduction in the engine-room staff of about ten men, or a net saving of nearly \$3,500 (£710) per annum.

Compared with a similar steamship the cubic capacity of

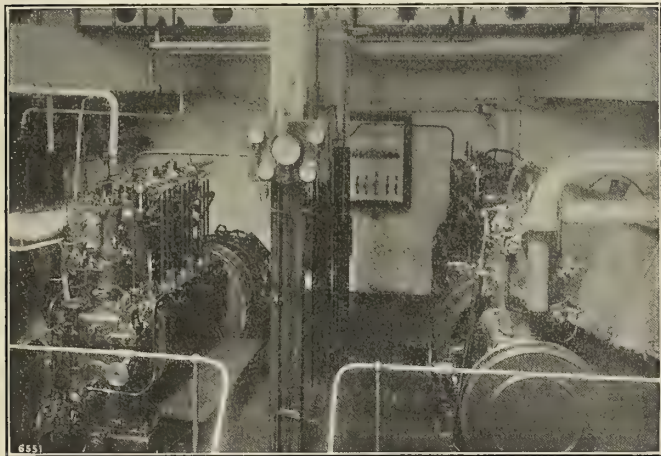


FIG. 3.—DYNAMO ROOM

fuel space is about one-fourth, so that a cargo gain of about 700 tons is effected, while owing to the small amount of room required by the engines an additional 200 tons of cargo space is gained, or 900 tons altogether.

Monte Penedo's engines weigh 150 tons complete, as against the 400-ton machinery of a similar size steamship. Thus the advantage of oil-engine power becomes apparent. Although designed for a loaded speed of $10\frac{1}{2}$ knots this has been exceeded, while on trial a speed of $13\frac{1}{2}$ knots was attained running light.

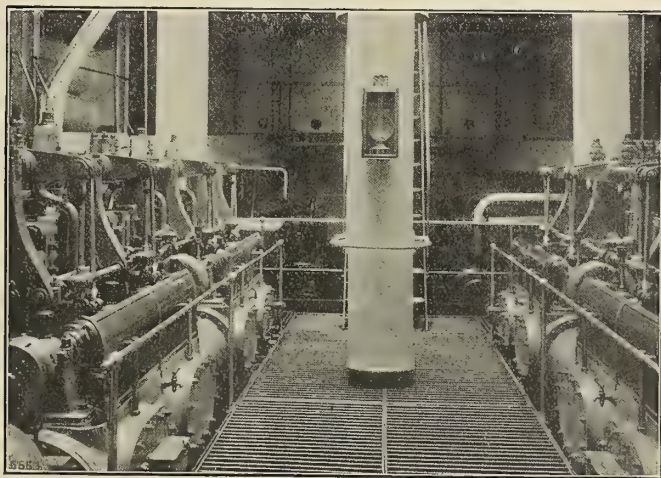


FIG. 4.—UPPER PLATFORM IN ENGINE ROOM

The machinery installation consists of twin Sulzer-Diesel engines for the propulsion of the ship and two smaller auxiliary Sulzer-Diesel engines, directly coupled to a dynamo and a compressor, respectively. Both the main engines are of the four-cylinder, single-acting type, working on the two-cycle principle, and at 160 revolutions per minute give 850 brake-horsepower, or a total of 1,700 brake-horsepower. (Cylinder diameter, 18.5 inches; stroke, 26.77 inches.) The bed plates are cast in three parts, and are of similar design to that of the marine steam engine. Naturally the cylinders covers are connected direct to the bed plates through steel columns, so that

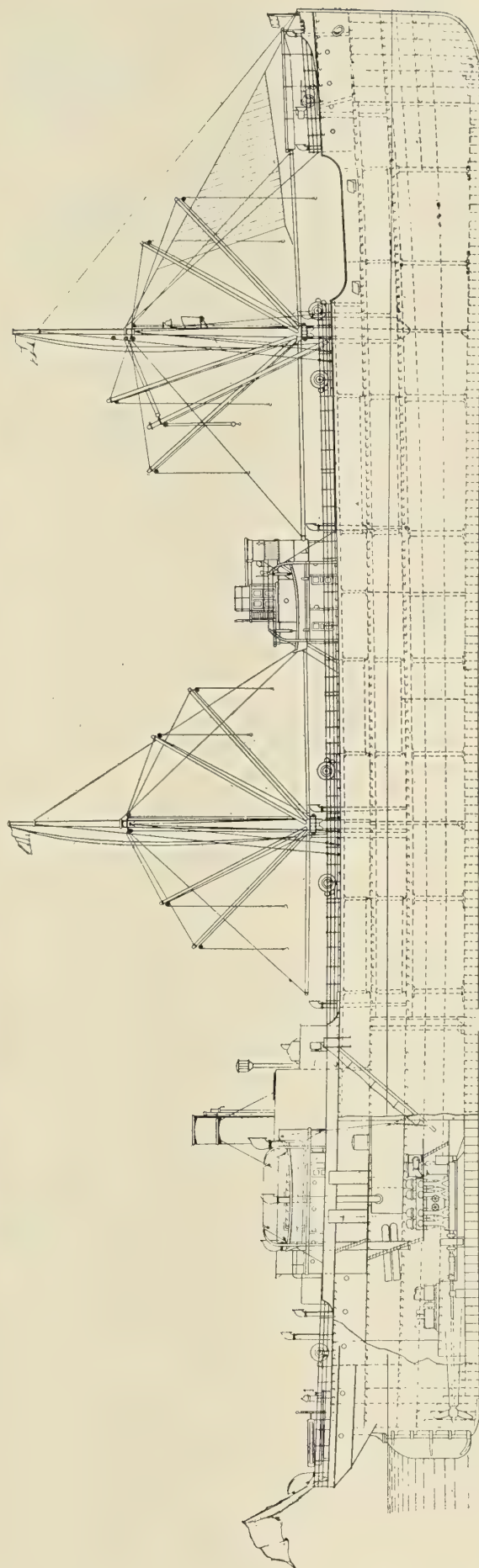


FIG. 5.—OUTBOARD PROFILE OF MONTE PENEDO

the explosive stresses are transmitted direct to the bed plate, leaving the body of the cylinders free from axial tensile stresses. This is very important where two-cycle engines are concerned, as the scavenging takes place through openings in the cylinder walls. In addition to the vertical steel columns cast iron columns are provided to take the transverse stresses and to provide guide surfaces for the crosshead shoes. The

Scavenging air enters the cylinders through two horizontal rows of ports in the cylinder walls; the lower row is controlled by the piston alone, while the upper row is controlled by the scavenging valves and eventually covered by the piston. By means of this upper row air to any desired quantity may be introduced into the cylinder after the piston has closed the ordinary scavenging openings. The exhaust openings are

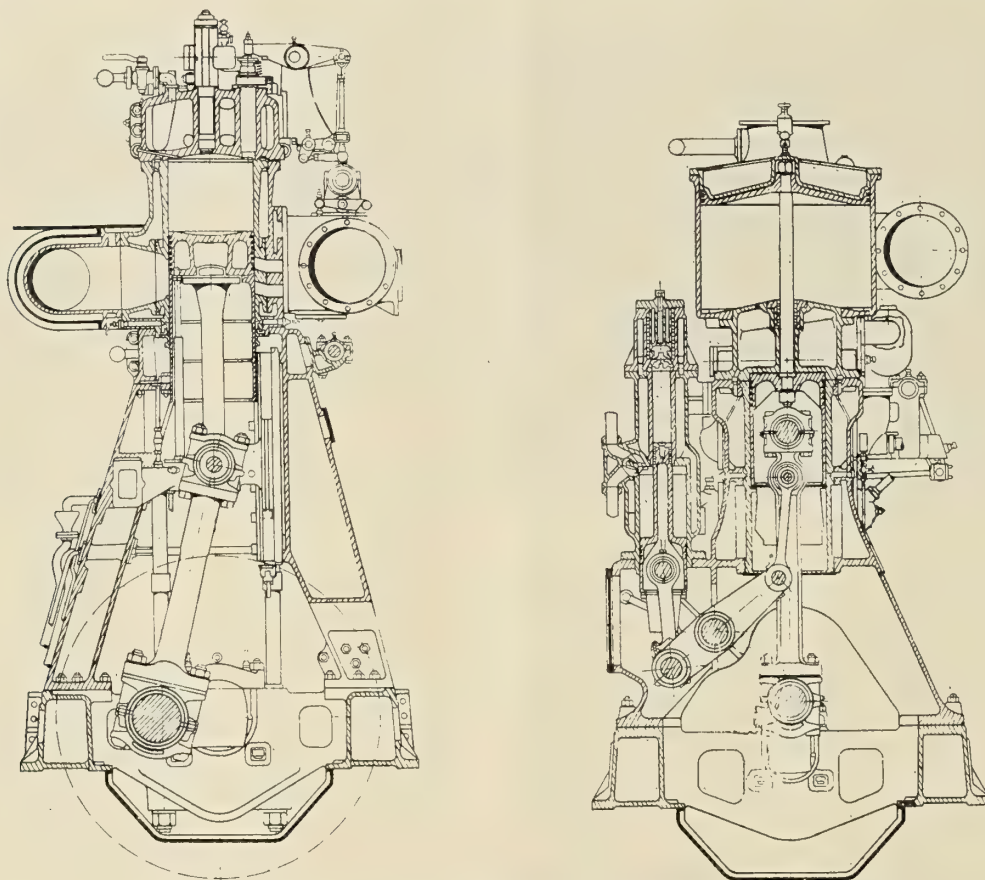


FIG. 6.—SECTIONS OF ENGINE THROUGH WORKING CYLINDER AND AIR COMPRESSOR

crossheads are provided with single-type guide shoes working on plates bolted to the columns, and the shoes are lined on their "ahead and astern" surfaces with white metal; the guide plates are adjustable and water-cooled. Planished steel plate doors enclose the engines, through which there is ample space for inspection and overhaul. Forced lubrication is provided for all working parts, the oil being cooled and filtered before being used a second time. A pump is fitted for the cylinder lubrication, the oil first passing through a sight-feed.

A most important and interesting feature is that the working pistons are water-cooled, and the water, led through telescopic pipes without stuffing-boxes, enters the piston head in the form of a free jet. All main cranks are set at 90 degrees, but the scavenging pump crank is set at an angle relative to the working cranks to give the best balance. The scavenging pumps are arranged on the forward ends of the crankshafts, and are controlled by a piston valve driven from the crankshaft through Stephenson link motion.

With regard to the compressors, these are of the three-stage type. The first stage serves as the crosshead of the scavenging pump, and the remaining two stages are driven from the crosshead through a patented system of balance levers. All three stages are water-cooled. Intermediate coolers are also provided, so that throughout the whole process of compression the air can be kept down to a suitable temperature. The compressor pumps are provided with automatic valves, so that no special reversing gear is required.

arranged on the opposite side also in the cylinder walls. The exhaust gases enter a water-cooled exhaust pipe leading to a silencer, from which they escape freely into the atmosphere. This method of scavenging gives not only excellent results in working, but from the point of view of simplicity of design and safety is a decided advance on other existing methods, for should a scavenging valve fail it is impossible for a charge to escape into the exhaust pipe. The cylinder covers are very materially simplified and free from the otherwise customary multiplicity of valves and gear, for in consequence of this design there remain only the fuel and starting valves to be mounted on the covers. At the same time the reversing gear is also simplified, and thereby easy to operate.

The maneuvering gear consists of two mechanisms, each driven by a little compressed-air engine through a worm-drive. One engine serves to rotate the camshaft through the desired angle relative to the crankshaft, and to put over the scavenging pump connecting rods into the required position for ahead and astern running; the other serves to operate the fuel and starting air valve gear for starting, running or stopping. Maneuvering may also be done by hand gear, so that should the maneuvering engines fail through any cause whatsoever no time may be lost in carrying out the orders from the bridge.

As may be seen from the photographs these maneuvering engines are placed central on the front of the main engines, and so near to one another that if need be one engineer can

control both main engines. A governor is fitted, which on the slightest increase above the maximum speed operates direct on the fuel pump and cuts off the fuel.

The pumps for the various services are driven by means of balance levers from the crossheads of both No. 1 and No. 4 cylinders, and are constructed on the customary ship design. They supply cooling water for the working cylinders, pistons,

machined on the periphery of the fly-wheel, which latter may be seen in the photographs.

We now come to the auxiliary machinery, which consists of two three-cylinder, single-acting Sulzer-Diesel motors of 8.07 inches bore by 8.66 inches stroke, working on the four-stroke principle. Both are of 50 brake-horsepower at their normal revolutions of 425 per minute. One is coupled direct to a

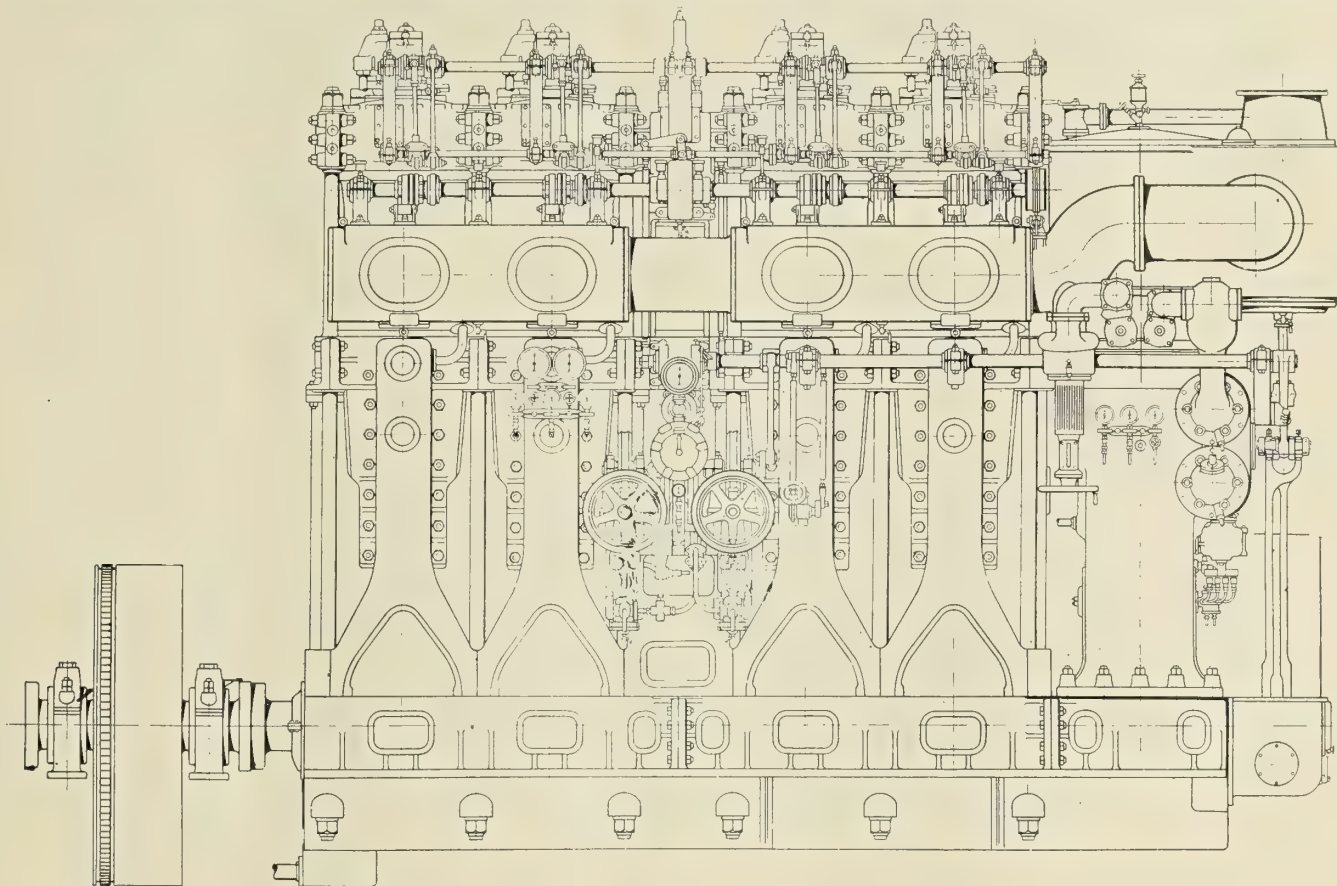


FIG. 7. —FRONT ELEVATION OF SULZER ENGINE

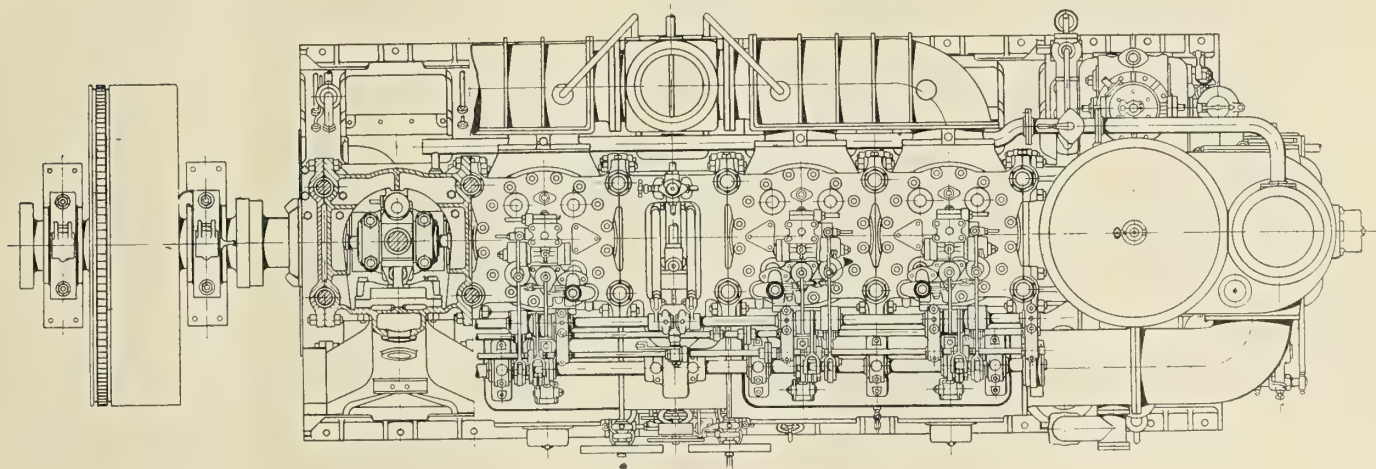


FIG. 8. —TOP VIEW OF SULZER ENGINE

compressor cylinders and inter-coolers, etc., and are connected for sanitary and bilge purposes. It must, however, be understood that the sanitary and bilge pumps were designed to be driven off the main engines at the special request of the ship owners, and in consequence the main engines appear somewhat complicated. A compressed air-turning engine is mounted at the back of each main engine, and drives through teeth

dynamo, which serves for lighting the ship; the other drives a compressor for use in case of emergency or failure of the ordinary air supply, but especially for use when entering or leaving a port, canal or in similar circumstances when large quantities of air are required for maneuvering. The dynamo and its engine weigh 7 tons. The engine frames are built in two parts and of box form, strengthened internally by col-

umns, while the engines themselves are enclosed by light planished steel plates, easily dismountable for inspection or overhaul. On the cylinder heads the fuel, starting, admission and exhaust valves are mounted, and are operated through vertical rods by cams mounted on a horizontal shaft enclosed in the engine frame. This cam-shaft is driven from the crankshaft through spur gearing. The valves and valve gear are similar to the usual stationary four-stroke motor design. The fuel pump is driven direct by the crankshaft.

An adjustable governor is fitted, which works on the well-known principle of controlling the amount of lift of the suction valves of the fuel pump. An oil pump for cylinder lubrication is cast in one with the fuel pump, the drive being common to both. Forced lubrication is provided for all bearings and gudgeon pins by a pump placed inside the engine frame

and which draws through a filter. The oil level can be read off a conveniently-placed gage. On the forward end of the auxiliary engines a semi-rotary wing pump, which is coupled to the crankshaft, supplies water for cylinder and compressor cooling.

The net weight of each main engine is 55 tons, or with all pipes, air flasks, exhaust, silencer, etc., 77 tons, while the air compressor and its driving motor weigh 6 tons, a total of 160 tons. The fuel consumption of each engine was proved on a forty-eight hours' run at normal working to be 0.46 pound per brake-horsepower-hour; but as the pumps for the various ship purposes are driven off the main engines the actual consumption is much lower, so the vessel will be very economical to work as far as fuel cost is concerned. The question of repairs can only be determined in time.

United States Naval Collier Orion: Built in Record Time

On March 23, just five months and seventeen days from the laying of the keel, the Maryland Steel Company, Sparrow's Point, Md., launched the new collier *Orion*, thereby establishing a new world's record for rapid ship construction. The vessel was completed in nine months and three days, the standardization trial taking place on July 9, off the Delaware Breakwater course.

She is one of two sister ships, the other being the *Jason*, now nearing completion at Sparrow's Point, and has an over all length of 536 feet, a length from the forward side of the stem to the after side of the rudder post of 514 feet, a molded beam of 65 feet and a molded depth of 39 feet 6 inches. The vessels are classed A-1 for twenty years under the American Bureau of Shipping and are built under the inspection of the Navy Department.

GENERAL ARRANGEMENT

The *Orion* is built on the Isherwood patent system of longitudinal construction, with the propelling machinery in the stern. The cargo is carried in six large holds, which are clear of stanchions, and by means of the topside tanks the coal is self-trimming. Five holds are fitted with two hatches each and the forward one with but one hatch. Forward of the cargo holds, under the lower deck, are four deep tanks for carrying cargo fuel oil. The inner bottom under the holds is also fitted for carrying cargo oil, and with the deep tanks has a combined capacity of 772,400 gallons. The topside tanks extend the length of the holds and are for water ballast only. The feed water is carried in the inner bottom under the engine and boiler rooms. The coal bunkers have a combined capacity of 2,248 tons and are fitted at each end and over the boiler room with a reserve bunker on the berth deck outboard of the engine room casing. The coal bunkers were designed with special attention towards eliminating trimming. A trimming tank is built between the after peak tank and after engine room bulkhead. Two domestic tanks of 20 tons total capacity are carried on lower deck aft of the engine room.

COAL-HANDLING MACHINERY

The contract requirement of handling 100 tons of coal out of each hatch per hour created such enormous stresses that a decided departure from the usual mast and booms was necessary, and the builders decided that the same design of coal-handling apparatus they developed for the collier *Neptune* would be satisfactory. The builders' wisdom in regarding this problem strictly as a coal-handling proposition, and not as a matter of appearance, was borne out when the operator handled over 137½ tons of coal per hour at the official test.

This test took place at the Norfolk Navy Yard upon the completion of the 48-hour run, the operator raising the bucket to a specified height and distance outboard of the collier's side. The coaling booms are of a built-up type and are designed for handling continuously a working load of 7,500 pounds under service conditions. To handle all the buckets twenty-four Lidgerwood winches are installed, two of which are of special design, with double drums for operating the fore and aft trolley.

DECK MACHINERY

The deck machinery is composed of a Hyde steam pump brake windlass, with two gypsy heads fitted for warping and engines located on the deck below. A Hyde capstan is fitted aft on the poop deck, with cylinders enclosed in the base. The steering gear is the Hyde right and left screw gear type, fitted with three wheels of hard wood for hand steering and operated by a steam-steering engine controlled by a telemotor operated from the bridge.

LIVING QUARTERS

The crew of 152 men are carried 'tween decks forward and aft, and 25 officers are quartered in a deck house on the poop deck. The crew's quarters are finished in red cypress, the officers' and captain's quarters and dining saloon in white pine and white oak. The mess rooms and warrant officers' quarters are in white pine and red cypress. The bridge house is in red cypress and white oak. The trim in the galley, pantries and bakery is of ash. Screen doors and windows are fitted in the officers' quarters, with Venetian doors to the inside of all entrances to officers' quarters. Steel bulkheads are fitted around showers, water closets, pantries, galley, bakery and lavatories.

The floors of the galley, bakery and pantries are covered with a non-porous tile, the officers' lavatory with a white vitreous tile and the crew's lavatory with asphaltum cement. Linoleum is laid in the walking spaces of the crew's quarters and other necessary spaces and throughout in the petty officers' quarters, hospital and officers' quarters.

Fowler & Wolfe radiators are installed throughout the ship, with the system draining through a trap to a filter box or condenser. Two Sturtevant direct-connected generating sets of 25 kilowatts capacity are installed for lighting the vessel and operating a 24-inch searchlight. Inter-communicating telephones are installed in the captain's room, on the lower bridge, aft on the poop deck, in the chief engineer's room and in the engine room. The wireless apparatus has a radius of 200 miles.

GAIN FROM LONGITUDINAL FRAMING

A feature that was observed on the *Orion* was that the deflection due to the load was 71 percent less than that observed on the collier *Neptune* under similar conditions. The deflections taken for the above percentage were the maximum in both ships and were taken at the same point. The cargo on both ships at the time the deflection was read was 10,500 tons of coal, 2,000 tons of bunker coal, 120 tons of feed water and 130 tons of stores and crew.

Due to the saving in weight of the structure resulting from the use of the Isherwood system, the *Orion* carried the specified deadweight on a draft of 26 feet 10½ inches in place

and contains eight 40-inch inside diameter corrugated furnaces. The total heating surface is about 18,900 square feet. A donkey boiler 8 feet diameter by 10 feet 4 inches long, constructed for 200 pounds working pressure and located in the bunker between the engine and fire rooms, is provided for port use.

AUXILIARY MACHINERY

The usual number of auxiliary machines have been provided, consisting of two 14-inch centrifugal circulating pumps, three long-stroke simplex feed pumps, a duplex fire pump, sanitary and fresh water pumps, two large evaporators with pump, two distillers with pump, an auxiliary condenser with



UNITED STATES NAVAL COLLIER ORION

of 27 feet 7¾ inches, as required by contract. This saving means an increase in deadweight of over 500 tons, or an additional earning capacity of 4 percent on the same initial cost and the same operating expense.

PROPELLING MACHINERY

The propelling machinery of the *Orion* represents the highest class merchant type. The two main engines were designed with special reference to economy and are of the three-cylinder, triple-expansion type. The cylinders are 27 inches, 46 inches and 76 inches diameter by 48-inch stroke, designed for a working pressure of 200 pounds per square inch. All cylinders are fitted with piston valves. The crank shaft is 14¾ inches diameter, in two pieces. One main air pump, two bilge pumps and an oil pump for forced lubrication to the thrust block are direct connected to each main engine. The main condensers are independent of the main engine framing and are located just outboard of each main engine.

As the machinery is in the stern, there is only one length of line shaft. The propellers are of the three-bladed, built-up type, with cast steel hubs and manganese bronze blades. They are 16 feet 6 inches diameter and 18 feet mean pitch, and the trials of the *Orion* demonstrated that these wheels admirably suited the required conditions.

There are three double-end Scotch type boilers operating under the Howden's system of forced draft. Each boiler is 15 feet 10½ inches mean diameter by 21 feet 4 inches long

attached pumps for port use, a pressure-type feedwater heater, two forced draft fans and a two-ton refrigerating plant. As the double bottom carries cargo, oil or ballast, there are two duplex pumps in engine room, cross connected to either service.

TRIALS

The 48-hour endurance trial run of the *Orion*, which was started July 10, proved very successful, the machinery running smoothly throughout, showing the following results:

AVERAGE FOR FORTY-EIGHT HOURS

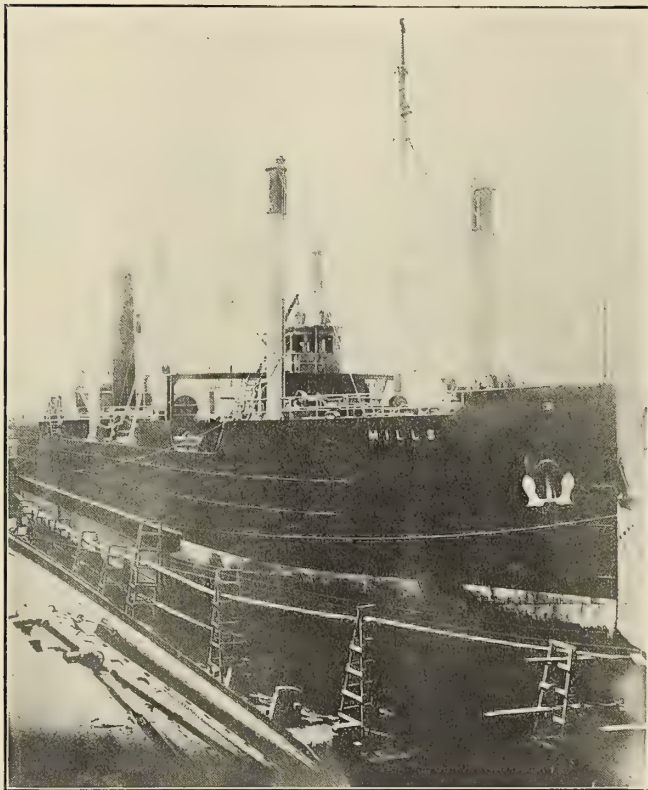
Revolutions per minute, average both engines...	95
Average steam pressure at boilers, pounds.....	195
Average steam pressure at engines, pounds....	192
Average air pressure in ash pit, water.....	1 in.
Average I. H. P. both main engines.....	6,943
Average speed for run, knots.....	14.468

The African steamer *Abosso* was launched recently by Messrs. Harland & Wolff, Ltd., Belfast, for the African Steamship Company, London (Messrs. Elder, Dempster & Company, Ltd., Liverpool, managers). The new vessel is 425 feet long between perpendiculars and 57 feet beam, with a gross tonnage of about 8,000. The propelling machinery, driving twin screws, consists of two sets of four-cylinder, quadruple-expansion balanced reciprocating engines, also constructed by the builders of the vessel.

The Steamship Mills—A Floating Fertilizer and Oil Factory

BY. C. B. EDWARDS

There are few ports which the fertilizer and oil-factory steamship *Mills* of Philadelphia makes which do not show great interest in the curious craft which captures millions of fish in a month and converts them into valuable products. Few indeed are the visitors allowed on board of this curious craft, and fewer yet are those who know that it is electricity which catches the fish, presses the oil out of them and grinds them up into fish scrap and fertilizer. Also it is this force which calls this craft to the fishing ground and summons other craft to take off the products when she is working at her full capacity, for, besides having all the machinery involved in the manufacture of fertilizer operated by electricity.



STEAMSHIP MILLS IN DRYDOCK

the *Mills* is provided with a powerful wireless plant. Nor is even this all that the electric plant on board of this unusual boat-factory does. In the busy season, which lasts from early spring into the late fall, the ship is at work all day and night taking in fish; and, to keep the work going at night as well as by day, arc lights and searchlights are called into use, which illuminate the ship so that the work is carried on uninterruptedly. There is some controversy as to whether the lights do not aid in attracting the fish to their destruction; but be that as it may, this boat, with its insatiable appetite for fish, never goes hungry from May till November, and brings back to her owners at the end of the season a million dollars' (£205,300) worth of products in oil and fertilizer.

The *Mills* is a ship of interesting history, and could she but relate her own experiences would tell a strange tale. A story of years of service, first as a suction dredge, later as a coast-wise freighter, and finally as a fertilizer factory; for she had been converted from one calling to another three times now, and this promises to be her last if the profits she made for

her owners during her first year of service as a fishing vessel is any criterion. To the casual onlooker she looks much like a torpedo-boat destroyer of the latest pattern, with many more than the required number of masts. These are the ventilating ports for the storage bins, through which electric blowers force the impure air from the inside. The *Mills* is not intended for speed and can make but slow progress, but for holding a large cargo she is unsurpassed. Some idea of the demands made upon the boat may be gained from the fact that she has to keep enough supplies on hand to feed her crew of 160 men for two weeks to a month at a time. She has to supply storage room for ten thousand barrels of food fish, and every day she converts the menhaden caught into eight hundred barrels of oil and twenty tons of fertilizer.

The *Mills* carries a complement of 160 men, divided into two shifts, one for day and the other for night work. When a school of menhaden fish is found, nets are slung over the side of the vessel and hauled in by electric hoists till the storage bins are full. Then the process of manufacture begins.

Screw conveyors, driven by motors, carry the fish into smaller receiving tanks and automatically feed them into steam cookers, and in a few minutes the fish are reduced to small particles. Then the cooked fish is forced through a rotary press to extract the oil, which is conveyed to testing tanks. Here, after it is found to be sweet and pure, it is cooled and allowed to flow into storage tanks of 2,000 barrels capacity. The fish scrap or fertilizer, from which all the oil has been extracted, is blown by an electric fan and dried as it is forced by the draft into other storage bins, where it is bagged as it arrives. This fish scrap is very inflammable, and the room in which it is stored is protected by an electric thermostat which notifies the commander in case of fire and allows it to be flooded at once.

As the menhaden are hauled up from the water by the nets, thousands of good food fish, such as bluefish, haddock and flatfish, are brought along with them. They are not good for oil and are worth a great deal for food, so they are sorted out by the workmen and placed in cold storage in a room which is electrically refrigerated by means of cold air and an ammonia cooling plant. Of course, it is not always possible for the boat to find schools of menhaden, and when they are not so plentiful smaller vessels are employed to do the fishing and bring them to the *Mills*, which acts only as a factory. The menhaden is an unusually prolific fish, though, and large schools are frequently discovered by smaller scouting vessels, which pass the word to the fertilizer ship by wireless, and she steams immediately to the scene of action. The fish look like herring, but are not edible, and when the *Mills* finished up her season last year she was fishing in a school off Nomans Land and extending to the South Shoal Lightship, a distance of eighty miles. The school was sixty miles wide.

When the storage tanks and bins are full, the wireless is called into use to summon barges and tugs to remove the cargo to the nearest shipping point. By this means a great deal of time is saved and the boat is always operated at its full capacity. While the *Mills* is an experiment, her first season last year netted her owners a handsome profit, and they express themselves as entirely satisfied; although it cost seven hundred thousand dollars (£143,600) to equip the boat with the electric and other apparatus necessary for her to carry on her work. The menhaden oil is an extremely useful material, essential in the tanning of leather, and recently a new use has been discovered for it in the mixing of paints.

Communications of Interest from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

Reliable Hand Wheels on Drain and Relief Valves

Most marine engineers have been annoyed at some time by the wooden hand wheels on drain and relief valves, sight-feed lubricators, etc., from their cracking and falling off on account of the heat, moisture and oil. On my job I have had all the wooden handles replaced with wheels made of red fiber, which have stood now for two years where wooden ones did not last a month. I have never seen any other hand wheels fixed in this manner, so this may be something new to many of the readers.

GREAT LAKES.

Strange Noises

When going down the river on the trial trip of a small coaster peculiar sounds, which had escaped the ear of the man in charge, were noticed by the engine designer.

On going around the engines he had the impression that these emanated from the air pump, which was of the reciprocating type, directly connected to the main engine by the usual lever arrangement; it had Kinghorn disk valves for foot, bucket and delivery, with access door to each set, and a snifting valve on the suction branch.

Now, the designer's impressions were verified when on lifting the snifting valve a pronounced knock was heard; he also noticed that on the down stroke some water was squirted out, pointing to a suction valve remaining open. By this time the ship was on the mile course, and it was with reluctance that the shipbuilder, anxious to get through the trials quickly, agreed to stop. On removing the access door to the foot valves the cause of the trouble was exposed. A piece of waste having been left in one of the pipes had choked the valve. This removed, the door was replaced, and in ten minutes all was running sweetly.

ENGINEER.

Dumbarton, N. B.

Fracture of a Rudder Head

While the steamship *M*— was bound from New York to several ports in South America and steaming against a heavy and strong head sea, the rudder head fractured between the quadrant and the main deck through which the rudder post went. The fracture extended from one side of the head to the other, and took a vertical direction along the head for about two feet.

The ship was fitted with twin screws, so that we were in a way able to bring her head-on to the sea and prevent further damage; for if we had got broadside-on to that mountainous sea I think we would certainly have fared very badly, and perhaps with fatal results.

Well, we set to work, and the deck officers made several attempts to rig jury rudders, but each time the sea carried all away. The engineers then tried to help matters a bit by lashing the broken parts together with $\frac{3}{4}$ -inch chain, but this was broken like twine. We then decided to try and utilize the spare cast steel bottom end, but, as it was too long to go between the bearing and the quadrant head, one side check of each brass had to be cut off. This was done by our drilling twenty-two $\frac{3}{4}$ -inch holes around the flange and splitting it off with a drift pin. The bottom ends were then tried in place, but as the rudder post was only 10 inches in diameter and

the crank pin was $13\frac{1}{2}$ inches diameter, we found it necessary to use packing. This was done by wrapping the $\frac{3}{4}$ -inch chain that broke around the fracture several times, and then securing the whole with the bottom end, which was bolted together with the spare top-end bolts; these being shorter and less in diameter, were easily fitted. It took us eighteen hours to complete the repair, and I must say it made a thoroughly sound job, enabling the ship to weather an exceptionally heavy storm for twenty-four hours after the repair was completed. Nothing of any note happened for the remainder of the voyage, and when we struck the first port thorough repairs were completed.

F. J. S. N.

Another Word as to the Use of Graphite in Boilers

Since the publication of my letter in the July issue of your magazine I have received several letters from various brother engineers, asking the kind of graphite I found best suited for removing scale and preventing corrosion in steam boilers.

Now I should like to caution my brother engineers against some of the cheap grades of graphite that are now being offered on the market for cleaning boilers and preventing scale formation. These inferior grades cannot with safety be introduced into steam boilers. In the first place graphite of this kind is too impure, containing as a usual thing from 20 to 50 percent graphite carbon. The impurities consist of clay, silicate, etc., which means that for every 100 pounds used there would go into the boiler from 50 to 80 pounds of scale-forming substance, which, together with the impurities naturally carried in the feed-water, would be too much for the 20 to 50 pounds of graphite carbon to handle.

Then, again, these cheap grades are only coarsely ground, whereas graphite to do the work which it should do in a boiler should be so impalpably fine that it will remain suspended in the water of a boiler in operation, and in circulating through it prevent by its mechanical action the formation of hard scale so difficult to remove.

I have found that amorphous graphite will give the best results, both for lubricating purposes and for removing and preventing scale formation. Flake graphite will not do the work as well as the amorphous will. The graphite mined in Mexico I have found from experience to be the best for steam boilers.

I hope that my letters will be the means of helping a good many of my brother engineers to get away from hard scale troubles, and without the use of strong chemicals.

Norwich, Conn.

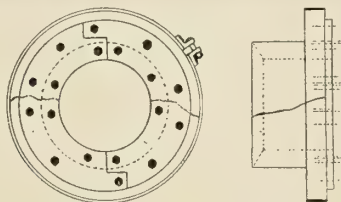
W. V. FORD.

The Repair of a Broken Stern Gland

There is a fine old Latin proverb which compresses a lot of marine engineering truth into the two words *festina lente*, which being interpreted means that there is no use in getting excited. Very often it pays a man to spare the time necessary to get out his pouch and fill his pipe before setting in to put things right which appear to be going to the dickens. There are cases, of course, where prompt action is the only way to save the ship, but there are other occasions when the cautious attitude of a dog tackling a hedgehog has to be observed. The matter in hand has to be looked at up and down, and likewise crosswise before anything is done.

This sermonette is prompted by a busy time which the engineers on board one vessel had, owing to the undue strenuousness in putting things right to start with. The original cause of the trouble was that a junior engineer had been told off to tighten up the stern gland a little. He had done it more than a little and had not set it properly. The result was that the gland warmed up beautifully, and when the trouble was discovered the ship's bacon could have been done to a turn upon it. Unfortunately the engineer who discovered the mess was of an energetic nature. He turned on a cock on the aft-peak ballast tank bulkhead, which let a stream of cold sea water onto the stern gland. The sudden contraction was too much for it and it broke as indicated in the sketches.

Of course there are other and more gradual ways of cooling off an overheated bit of metal, and the engineer would probably have thought of them if he had given himself time. It



SKETCH OF REPAIRS TO BROKEN STERN GLAND

may be interesting, however, to describe how the trouble was got over. The engines, of course, had to be stopped, and the way the repair was carried out is also indicated in the sketches. A band was first made out of a strip of $\frac{1}{4}$ -inch plate, long enough to go round the circumference of the gland flange, and at its ends there were riveted two lugs of stout cross-section, as shown in the sketch. Through holes in these lugs a $\frac{7}{8}$ -inch bolt was passed, and when this had been tightened up the bolt gripped the flange of the gland and drew the broken parts tightly together. When this was done a piece of boiler plate $\frac{1}{2}$ inch thick was taken and pieces cut out of it of the shapes shown in the sketch, so that the two fitted fairly accurately together and encircled the shaft. The division between them was, of course, necessary in order to get the plate over the shaft. These pieces of plate were then held in place on the gland, and $\frac{5}{8}$ -inch tapping holes were drilled through the plate and into the flange. When these were tapped and $\frac{5}{8}$ -inch tap bolts were screwed in, the two broken halves were secured firmly together, and the repair held for two and a half months without any trouble before it was feasible to get a new gland put in. All the same, *festina lente* is a very good motto.

J. J. M.

A Curious Marine Mishap

When the American steamship *Virginian* and the British tramp steamer *Strathalbyn* collided off Three Tree Point, half-way between Seattle and Tacoma, one night last winter, it resulted in one of the most serious marine mishaps on Puget Sound in years. While only one life was lost the damage to the two big steamships approximates \$100,000 (£20,500). The *Strathalbyn* was repaired at the plant of the British Columbia Marine Railways, Esquimalt, B. C., while the *Virginian* went into service again after repairing in Seattle at the plant of the Seattle Construction & Drydock Company.

The *Virginian*, 5,077 net tons, of the American-Hawaiian Steamship Company, was proceeding to Tacoma to complete loading for the Hawaiian Islands. The *Strathalbyn*, 3,602 net tons, of the "Strath" fleet, owned by William Burrell & Son, of Glasgow, was bound from Tacoma to sea with 3,500,000 feet of lumber for Sydney. Both vessels were in charge of licensed pilots. At the time of the accident, which occurred at about 8 o'clock, the night was dark but clear, with a light rain not sufficient to obscure the vision.

The testimony of the officers of the two steamers conflicted in important details. The burden of the story of those on the *Strathalbyn* was to the effect that the British steamer blew one whistle for passing port to port. At that time both the red and green side lights on the *Virginian* were visible. Receiving no answer from the American vessel, the *Strathalbyn* again blew one whistle, no response being made. By this time the *Virginian's* red light disappeared. Then the *Strathalbyn's* helm was ported and her engines stopped. One minute later the *Strathalbyn* again gave one whistle for the *Virginian* to pass her to port, the *Virginian's* whose green light only was visible, again failing, it is claimed, to answer. Then the British tramp backed full speed astern, sounding several blasts in quick succession as a danger signal. Three blasts came from the *Virginian* in response thereto.

On the other hand, officers of the *Virginian* state emphatically that they saw no lights on the *Strathalbyn* until the latter hove in sight, and it was too late to avoid the collision. Passengers and officers on local seamers which passed the freighters a short time before the mishap testified that they saw the *Strathalbyn's* lights, but added that they were dim. The master and officers of the *Strathalbyn* admitted that the steamer's electric light plant went out of commission just prior to leaving Tacoma, but they claim that oil range and side lights were substituted sufficient for all purposes. Sifting the entire testimony, which is conflicting in the extreme, there seems to be no clear reason for the mishap, and it is likely that the resulting libel cases from both parties will be in the courts for adjudication for a line time.

Notwithstanding the severe injuries to both vessels, the masters refused assistance and both proceeded to Tacoma, where the *Virginian* arrived three hours later and the *Strathalbyn*, seriously crippled and with No. 1 hold filled with water, stem almost submerged and a heavy list to starboard, five hours after the mishap. The *Virginian* was not badly injured, and at Tacoma continued to work cargo. The *Strathalbyn* made fast to a buoy, but the next morning she began taking water at such an alarming rate that she was beached on the flats, where, as shown in the accompanying photograph, she appears like a total wreck. The lumber cargo was discharged from No. 1 and No. 2 holds, the water pumped out, and when the vessel righted it was seen that the damage did not extend below the water line. In this condition she steamed from Tacoma to the Esquimalt dock at Victoria, B. C. It was found that when lying at the buoy with a serious list water was pouring below through the ventilators, making beaching necessary.

In the accompanying photographs is told an interesting story of the mishap. Incidentally they show how much more seriously the British steamer was damaged, testifying to the better material in and construction of the American vessel. Striking the *Strathalbyn* on the latter's port bow, the imprint of the British tramp's port anchor is easily seen on the starboard bow of the *Virginian*. The *Strathalbyn's* stem was twisted many feet to starboard, and in the photograph her port anchor is seen about where the starboard anchor should be. On the starboard side of the *Strathalbyn* the forecastle was completely torn away, the plates being crumpled up for a distance of 10 feet below the main deck aft to 8 or 10 feet into No. 1 hold. The wreckage hung overboard on the starboard side for 8 or 10 feet beyond the side of the vessel. In this mass of crumpled plates the body of the one victim of the mishap was found. Until the wreckage was cleared away he was thought to have been washed overboard. When the *Strathalbyn* left Tacoma, this wreckage, weighing about 20 tons, was released and dropped into deep water. The photograph also shows how the forecastle was laid open and how the starboard anchor and chain were pushed aft to almost abreast of the foremast. The photograph was taken while the



WRECK OF THE STRATHALBYN



DAMAGED BOW OF THE VIRGINIAN

Strathalbyn lay beached in Tacoma harbor, and she was the most curious spectacle of a marine mishap seen hereabouts in many years. Repairs are estimated to cost about \$60,000 (£12,300).

For repairing the *Virginian* the specifications called for

removing the stem from the upper deck to the first scarf, fairing and returning; renewing six plates on the port side, removing and fairing two; five new plates on the starboard bow, four to remove and fair and one to repair and fair in place; on the port side two frames to fair in place, and on the starboard side three frames to renew and six to fair and replace. The two breast hooks were also faired. There was some damage below the waterline extending into the fuel oil tank in the forepeak. The injury on the starboard side included a rip about 12 feet long and 10 to 12 inches in width above the oil tank. Above this, four plates were found punctured on starboard side. On the port side one plate was punctured and others bent. Compared with the *Strathalbyn* the *Virginian* fared very well. The *Virginian* was repaired by the Seattle Construction & Drydock Company, time allowed being eighteen days. The contract included docking at Puget Sound Navy Yard, as no other dock on Puget Sound could accommodate the vessel. At first the owners figured on making only temporary repairs here, later docking and repairing permanently at San Francisco. However, the local firm made an attractive offer and all the work was done here.

The local board of United States Steamboat Inspectors, after hearing considerable testimony in this case, have reached the conclusion that they have no jurisdiction. On Puget Sound pilotage is not compulsory for vessels under registry, and pilots operating in these waters on vessels under registry are subject only to State officials. As a result the entire matter will be decided in the courts, the Federal inspectors having decided to take no action whatever.

Seattle, Wash.

R. C. HILL.

An Effect of Galvanic Action

Marine engineers are too often absorbed by the routine of their daily duties to bear in mind the more extraordinary causes of breakdown, but occasionally occurrences come round which remind them that one cannot be safe without keeping one's wits and eyes about. It is, of course, a well-known fact

that dissimilar metals have a galvanic action upon one another, especially in the presence of a good conductor of electricity, such as salt water. If these two metals are in contact with one another and exposed to sea water, local electric currents are set up which eat up the material from which the electric "cell" is formed. The same thing is sometimes taken advantage of in boilers in order to direct corrosion from the boiler plates and tubes to some material that does not matter so much when a block of zinc is hung from one of the stays and dipping in the boiler water. The zinc becomes eaten away instead of the iron.

Sometimes, however, this action is not in favor of but against safety, and designers of vessels must occasionally forget about it, or else an incident such as the one about to be described would not have taken place. On one occasion, while a ship was under steam, one of the boilers was being blown down, when, without any warning, the blow-down cock on the ship's side fell down out of its place, and there was a heavy inrush of sea water. The boiler was, of course, at once shut off, and the stream of incoming water into the stokehold was stopped for the time being by hammering a plug of soft wood into the ship's side.

The trouble was as indicated in the first illustration. The spigot on the blow-down cock casting, which was of brass, passed through the ship's side in order to carry the water over

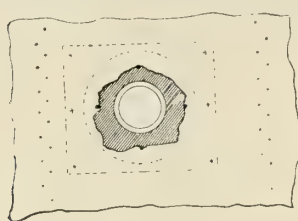


FIG. 1

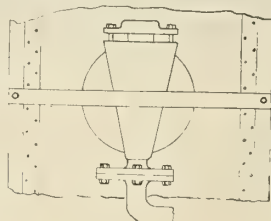


FIG. 2

the plate. Owing to the contact of the steel of the plate with the brass of the spigot in the presence of sea water a galvanic action had been set up which had the effect of corroding the ship's side. This, of course, could not be seen, and so was undetected until the corrosion had eaten its way so much towards the bolt holes securing the flange of the cock to the side of the ship that the plate was too weak to stand and the cock fell away. The area of corrosion is shown shaded in the sketch.

The way in which a temporary repair was effected, sufficiently good to keep the cock in commission till the vessel reached the home port, can best be understood from the second illustration, which shows a view of the repair from the inside of the ship. A strong iron band was made out of $\frac{3}{4}$ -inch iron, long enough to pass from one of the ship's side frames to the other across the location of the opening, and shaped so that when tightened up it would bear on the cock so as to press its flange against the unbroken portion of the plate. A rubber insertion joint was then cut suitably to make a water-tight joint between the flange on the blow-down valve and the sound portion of the plate. The wooden plug was taken out again and the cock was put in place with the insertion joint in position, the iron band was then put on and screwed tightly in place, and finally the disused bolt holes, which, of course, were letting water through freely all the time the repair was being effected, were plugged up with wood.

This, of course, could not be regarded as a permanent repair, and on arrival at the home port, where full engineering facilities were available, a $\frac{1}{2}$ -inch covering plate made of brass was fixed to the outside of the ship's side, as shown dotted in the first figure, and the blow-down cock was secured to this by means of bolts passing through the holes in the flange. This effected a permanent job which was satisfactory.

J. B. Brooks.

Total Breakdown of High-Pressure Engine

The steamship *B*—— broke down while at sea on a voyage from London to Constantinople with a general cargo. She was towed into the nearest port, which happened to be Cherbourg, in France.

Upon the surveying engineer examining the engines, it was found that the forward one was shored up from the keelson by means of spars cut for the purpose, and shored sideways to the bunkers and vessel's side. This we had to do to prevent the cylinders coming down bodily after the accident, owing to the cutting away of all forward support (which I will endeavor to explain later on) and the rolling of the vessel.

Upon further examining the machinery it was seen that the accident was due to the fracture of the connecting rod bolt in the bottom end of the rod, and the fracture extended for about three-quarters of the entire length of the bolt. This fracturing of the one bottom end bolt had the effect of shearing the fellow bolt close up to the nut end. The metal of the bolt which fractured showed itself to have been very reedy, and that only about one-half of its area was available for work. This flaw may have existed from the first and yet not be visible on the surface.

Owing to the fracture of these bolts the piston, with its rod and the connections of the forward engine, had made a violent stroke upwards which broke several of the studs securing the cylinder head and started them all. The steam by this time had been admitted on the top side of the piston, causing it to make a down-stroke with greater violence still, the result being that the foot of the connecting rod struck the starboard cast iron column of the forward engine, completely severing it at the foot, and displacing it to the extent of about 6 inches. It was also cracked half round just below the surface of the slipper, and it had also started on the top at the foot of the cylinder, the bolts next the center line of the engine being broken.

While the connecting rod was in the position mentioned the crank of its engine was brought round by the after engine, and struck the rod just above its foot, bending the latter in two directions, and also bending the piston rod cross-head in one of the bolt holes. This caused the slippers (or shoes) to be immovably jammed between the guides, the tendency of the cross-head being to force the guides apart. This no doubt caused in some measure the displacement of the starboard column and the fracture in five places of the port or condenser columns.

It was impossible to send the vessel home without effecting temporary repairs; but the question was where to get any shop assistance, the only establishment approaching an engineer's workshop being what we would call out here a blacksmith's shop. This shop contained five fires, two small lathes, a drilling machine and a steam hammer. When we set eyes on the latter tool we entertained great hopes, as wrought iron was the only material for such a repair. But to our dismay we found the firm had not enough steam at their command to use the hammer. Castings could not be obtained except from a great distance, but then there were no pattern makers, consequently inquiries were made concerning getting work done by the navy yard authorities, but they would give us no assistance unless a private firm could not be obtained to undertake the work, and that private firm had to make a declaration to that effect. This the firm declined to do. It was remarked that it would take them three months to do the work. Their answer was that that was possible, but that they would "do it in time," and would make no declaration of inability. Consequently we had to make the best of the appliances at our command, and the ship's firemen were turned into machinists, work which they did most willingly, and

worked night and day, making use of the little workshop to the best advantage.

We commenced to disconnect the disabled engine, and it was with the greatest difficulty that the connecting rod could be disengaged from its position, the withdrawal of the guide plates jammed by the bent cross-head being an operation of great difficulty with the appliances at hand. However, after nearly three days' work the connecting rod and guide plates were got out. The cylinder head was next lifted out, with a view to drawing the piston and removing the piston rod in order to straighten it. We got two disused dredger links, and we used them together with two 1½-inch screw plates and nuts to draw off the piston from the rod, but found it to be immovable, at the same time using a 4-cwt. steel ram, worked by ten men, to strike the end of the piston. Finding that this failed we built a charcoal fire around the piston eye, which we kept going without any successful result. We next tried sulphuric acid around the cone of the piston rod for several hours, and then the ram was again used for some hours, but still the rod would not start.

It was then decided to break off the tail end of the piston rod, which works through the cylinder head; we did this, and the fracture then showing it to have been half broken through already. The only plan left was either to split the piston or drill out the piston rod, both serious questions, the one method entailing a casting, the other the welding on a new cone and screw to a piston rod 4¾ inches in diameter at a common smith's fire and by hand, this weld having to stand the whole stress of one engine. It was ultimately decided to adopt the latter method.

After this had been accomplished it required several blows with the heavy ram to start the rod. On examination it was found that the piston rod had been driven ¾ inch over the cone and into the piston, and yet the piston had not split.

Having got the piston, piston rod and connecting rod out, ready for heating and straightening, the cylinders were then lifted by means of shores and wedges, and endeavors were made to wedge the broken columns back into place. This having been done, and some small pieces of ¾-inch boiler plate having been found in a store yard, the patches were begun. The one on the starboard column foot was supplemented with a plate inside. The plates had to be worked hot to place, and were secured by 1-inch bolts and nuts, the holes being drilled and tapped.

It was in the meantime that we decided to support the engine by means of wrought iron ties and struts, leaving the broken columns the duty of supporting the guide bars only. We then procured some lifeboat davits, 3 inches diameter, from the navy yard, as used on the warships. These were used to construct the ties and struts which were already in place.

Our next job was to straighten the piston rod; it was got fairly true and quite sound. We next had to weld a new end on the piston rod, and I am glad to say that this was done in a most satisfactory manner. The piston rod had then to be turned up, when, upon examining the finished collar, it was found to be cracked half-way round its circumference. We could not procure a new rod for a long time, perhaps for weeks, so we set about another plan. A hole 2¼ inches diameter by 8 inches deep was drilled through cross-head and up into the piston rod, and into this was screwed a 2¼-inch fine threaded steel screw, and in addition we had forged, bored and shrunk on a wrought iron clip, which was again secured to cross-heads by means of two turned bolts.

The connecting rod was in the meantime got approximately true, and the connecting rod keep having been straightened as well as the cross-head bolts. The reconnection of the engines was then proceeded with, and we had considerable difficulty in getting all fair, having to use a pair of old and

nearly wornout connecting rod brasses instead of a pair of new ones in store. This made the connecting rod bolts ¾ inch too long, which necessitated the making of a new wrought iron keep.

Well, after a bunch of hard work we got the engines together again, and everything being coupled up and finished, steam was got up and the engines started and kept running for twelve hours. No signs of springing, heating or weakness having developed the vessel proceeded on her voyage. The engines drove the vessel from Cherbourg (France) to London at an average speed of 6 knots without mishap or stoppage.

Upon our arrival in port, and on an examination being made, it was found that the temporary repairs had stood well, there being no signs of failure or weakness in any of the many patches or stays. The machinery, however, had been so strained that it was necessary to completely dismantle the engines, consequently the cylinders and their connections, pistons, piston rods, connecting rods, valve gear, engine columns, air pump buckets, links and cross-heads, feed and bilge pumps, circulating pump, crankshaft and brasses were all removed from the vessel to the shops. The removal of the cylinders necessitated the lifting and repairing of the engine-room skylight.

Upon examining the various details it was found that the boxes of the cylinders, having been cut owing to their having become out of line, due to the strain caused by the rolling of the vessel before the forward engine was secured by shores at the time the columns were cut away, it was necessary to remove them. Two new pistons, complete with brass bolts, had to be supplied and fitted, the forward one having been destroyed at the time of the accident, and the after one being too small for the rebored cylinders. A new forward piston rod and cross-head was necessary to replace the broken one at time of accident. A new slide rod complete had to be fitted to the forward engine, the old one being found to be cracked at the neck. The connecting rod of forward engine had to be straightened in the fire and fitted with a complete set of new brasses. The connecting rod of the after engine also required new brasses, the old ones having been worn all away owing to the distortion of the centers of the engines. Two new columns with guide plates and air pump lever bracket were supplied and fitted complete to replace the ones cut away at the time of the accident. The air and circulating pump levers, links and gudgeons required overhaul. A new air pump, head valve and guard were fitted, the old ones having been broken at the time of accident. A new set of India rubber valves had to be fitted to replace those destroyed. A new trunk had also to be fitted to the circulating pump cover and also new valves. The starting, reversing valve and throttle valve gear had to be overhauled and adjusted. The main steam pipe required repairing and testing, as did also the steam connections to the donkey in connection with it. The crankshaft had to be lifted and adjusted. The same was also done to all the propeller shafting.

The propeller needed rekeying. The water service for crank pins and crankshaft bearings had to be replaced. A set of new lubricators had to be supplied, the old having been destroyed. The pressure gages were retested. The main condenser was overhauled and 51 tubes were found to have started, and these were made good. New indicator cocks and pipes had to be refitted to replace old ones damaged. A new gland and neck bush had to be fitted to the after cylinder, the original one being much cut owing to the accident.

The necessary work was completed in six weeks (the temporary repairs having occupied only twenty days), from which the serious nature of the accident will be seen, when so long a time was occupied in remedying defects at a modern engineering shop with every appliance for the speedy execution of repairs.

F. J. S. N.

Review of Important Marine Articles in the Engineering Press

Motor Passenger Launch Violeta.—A handy little vessel built by Thornycrofts for the Algeciras Railway Co. for service between Gibraltar and Algeciras. A present the company operates a fleet of paddle steamers on the route and the new boat's performance will be an interesting comparison. The especial service for which the *Violeta* was built is the carrying of British Government mails and passengers between mail trains, to and from liners calling at Gibraltar, and acting as general handy boat to the steamers of the fleet. The vessel is 66 feet over all, 60 feet on the water line, 12 feet beam and 5 feet draft. She has a displacement of 35 tons, a passenger accommodation of 60 and a speed of 11 knots. The machinery consists of two sets of six-cylinder, four-cycle gasoline-kerosene (petrol-paraffin) engines of Messrs. Thornycroft's well-known C type, developing 70 to 80 horsepower and driving twin screws through epicyclic transmission gear at 500 revolutions per minute. A special feature is the lubrication. 700 words, with photographs and complete drawings of general arrangement.—*Engineering*, May 31.

The New German Battleships Heligoland and Kaiser.—Two distinct types of battleship design are illustrated in the last designs for the German navy. The earlier of these is for the *Heligoland* class, launched in 1909-10, and the latter the *Kaiser* class, launched in 1911-12. The dimensions of the former are: Length 546 feet, beam 93½ feet, draft 27 feet. The main armament is composed of twelve 12.2-inch guns, four of which are in turrets on the center line of the ship; the rest are in four turrets at the corners of the superstructure. A secondary battery of fourteen 5.9-inch guns is carried on the main deck. There are six torpedo tubes. The armor protection is said to be particularly effective and complete. Practically the entire hull side is armored, the maximum thickness being 10¾ inches. Turrets and bases have 11-inch protection. The normal fuel capacity is 1,900 tons, with a maximum capacity of 3,000 tons of coal and 200 tons of oil fuel. With a designed indicated horsepower of 28,000, a speed of 20.5 knots was expected, but this has been exceeded by a knot. The *Kaiser* class is 564 feet long, 95 feet beam and 27 feet draft, and of 24,500 tons displacement. The designed horsepower of 25,000 is expected to give 21 knots speed. The arrangement of guns is after the design of the British battleship *Neptune*. There are ten 12.2-inch guns and fourteen 6.7-inch guns, with ten torpedo tubes. The armor is very similar to that of the *Heligoland*. A comparison of the nine latest battleships building for seven of the powers is appended. Illustrated. 2,000 words.—*Marine Engineer and Naval Architect*, July.

The Battle Cruiser.—By Burnell Poole. An exposition of this recently evolved type of warship for the general scientific reader. Describes the necessary qualifications and sketches the history of their development, followed by tables of principal dimensions of the battle cruisers of the world's powers. Illustrated with photographs of good examples of battle cruisers. 1,400 words.—*The Engineering Magazine*, July.

The Strength of Ships—Part I.—The first of two articles giving notes from a recent German work under the above title. In beginning, attention is called to the circumstance that one of the salient characteristics of a ship, that of being largely made up of thin sheets of plating, is not met with in other structures in anything like the same degree. For this reason, and because the stresses due to wave action cannot be treated by ordinary methods, a new branch of science has to be created. The point made in this number by the reviewer, and illustrated with examples of mechanical action of ma-

terial under stress, is that material in a ship's structure is much more often over-stressed than is supposed. This being beyond the yield point and being accompanied by permanent elongation of the material, it must not go so far as to lead to fracture, and the elongation must not be of such a nature to be detrimental to the general structure. That such a state of affairs exists is claimed and shown to be possible by considering the manner of making the joints in such a way that a very little yield relieves the stresses acting throughout the structure. 3,000 words.—*The Engineer*, June 28.

The Strength of Ships—Part II.—The scope of the remainder of the book is given, and briefly stated this is: Stresses on plates supported at the sides and loaded throughout its area, rivets and riveting, longitudinal stress and longitudinal framing, water pressure on sides and bottom plating, transverse strength and the effect of frames and bulkheads thereon, docking, and stresses in special parts—as thrust blocks, engine seatings, etc. Nothing can be given here satisfactorily of the treatment accorded any of these subjects. Its value may be judged from its sources, the vast data of the German navy backed up by large numbers of tests upon many parts of structures to determine what actually happened under service conditions. 3,700 words.—*The Engineer*, July 5.

Harland & Wolff's Works at Belfast.—Besides being one of the world's greatest shipyards in point of tonnage built, the Harland & Wolff Works at Belfast is especially noteworthy in the superior location and equipment of its plant. Rarely does an organization have the advantages offered by such equipment in the building of its enormous output. Its story is told from the modest beginning in 1791 to the present time, when, under the direction of Lord Pirrie, a larger ship than the *Olympic* is being built. The yard as it exists to-day is the subject of full and complete description, with some remarks on the policy of the company's management. Every department is taken separately and fully treated. Accompanying are several photographs and plates. 27,000 words. In two parts.—*Engineering*, July 6 and 12.

The Holzapfel Patent Exhaust Boiler and Silencer.—A device making use of exhaust gases from internal combustion engines to generate steam for auxiliaries, particularly the steering engine. It consists of two cylindrical, tubular boilers placed side by side, so piped up that the hot gases may be passed through each at will. The gases pass through the tubes, water surrounding them. Sea water is used, and in order to reduce incrustation a continual drip of brine is allowed to leave the boilers. Compressed air is used while leaving port before the heat of exhaust is sufficient to put the steam steering gear into commission. The apparatus is being put on the market by the Holzapfel Marine Gas Power Syndicate, Ltd., of London. Illustrated by a drawing. 400 words.—*Marine Engineer and Naval Architect*, July.

On the Best Distribution of Load Among a Number of Similar Steam-Turbine Stages Working in Series.—By E. Buckingham. A mathematical deduction of the commonly accepted solution of the problem of load distribution in compound steam turbines. While generally believed to be true, the hypothesis has generally been accepted, although not rigidly approved. The conclusion reached for both two and multiple stage turbines is that the isentropic drop should be a little greater in the first stage than in any other, slowly and uniformly decreasing from this to the lowest pressure. 300 words.—*Journal of the American Society of Naval Engineers*, May.

The Gary-Cummings Torsionmeter.—By Com. U. T. Holmes. An accurate mechanical torsionmeter as used in the United States navy is here described and shown in drawings. Briefly stated, it consists of a tube rigidly fastened at one end inside a section of hollow shafting, the other end turning in roller bearings which are made fast to the shaft. As the shaft twists under a load, the tube turns in the bearing. The amount of turning is magnified and the result recorded by metal points touching a slip of paper held tangent to the edge of the recording instrument. The degree of twist of shaft is directly proportional to the distance between the points of contact on the paper. In the instrument described, $\frac{1}{2}$ degree of angular displacement of shaft was marked by 1.9 inches between the recording points. The advantages of this instrument are that it is unaffected by speed of revolution, and therefore uses the same constant for all speeds and powers; it is inside of the shaft, out of the way; weighs little and needs no adjustment after once being calibrated. A set of formulæ is worked out for use with the instrument. 2,500 words.—*Journal of the American Society of Naval Engineers*, May.

Kermode's Liquid Fuel Systems.—The use of oil for fuel is being pushed for consumption under factory boilers, rivet-heating furnaces, fire engines, melting metals and tea drying, as well as under naval boilers. The firm of Kermode's, Ltd., of Liverpool, has been developing liquid fuel systems applicable for all these uses and more, and hardly three months pass without notice of some further advance being made in the model of the burner or the method of administering oil fuel. One of their latest designs for marine work permits either fuel oil, coal or both to be used without changing the furnaces. For oil fuel three systems are in use: (1) the steam-jet system, which will recover in actual work 75 percent of the calorific value of the fuel used and the burner will work efficiently on 3 to $3\frac{1}{2}$ percent of the steam raised; (2) the air-jet system, which will recover 84 percent and uses but 2 percent of the steam raised; (3) the pressure-jet system, which recovers 80 percent of the fuel in work and uses about $\frac{3}{4}$ percent or under in driving the pump. In the two last-named cases the water to drive the system may be recovered. As to comparative evaporation, whereas ordinary coal evaporates 8.5 pounds of water from and at 212 degrees in marine boilers, ordinary fuel oil of commerce, of calorimeter 19,320 British thermal units per pound, will evaporate 16.5 to 16.8 pounds of water from and at 212 degrees with the air-jet system, 16 pounds with the pressure-jet system and about 15 pounds with the steam-jet system. Photographs of the different types of installation are shown. 4,200 words.—*The Steamship*, July.

The Selandia's Maiden Voyage.—Much of uncertainty regarding the use of Diesel engines for deep-sea service in medium and large ships can only be cleared away by actual trial, and so the reports from the *Selandia's* first voyage have been awaited with interest. On a trip of 21,840 miles this ship carried 9,300 tons of freight on a consumption of 9 tons of fuel per 24 hours, with a total engine-room crew of ten men and three boys. Although some rough weather was encountered and stops were made at sixteen ports, no trouble was reported in running or maneuvering the engine. The piston rings were examined twice and found to be perfectly clean. The exhaust valves needed practically no attention the entire trip. Only in the auxiliaries, such as lubricating oil pumps and water circulating system, were any changes suggested by the experience, and these were modifications in size rather than in method of operation. The voyage seems to have disclosed no inherent defects in the four-cycle motor, as had been feared by some. 900 words.—*The Engineer*, July 19.

Screw Propellers. Determination of Diameter, Pitch and

Projected Area by Means of the Effective Thrust.—By Capt. C. W. Dyson, U. S. N. All previous work on propellers by Capt. Dyson was made on the assumption that the apparent slips and propulsive coefficients of propellers working in the wakes of similar vessels, at equal indicated thrusts per square inch of projected area, varied directly as the projected area ratio. His method was to lay down the slips and propulsive coefficients for a propeller of .32 projected area ratio and one of .54 projected area ratio, and assume that the slips and propulsive coefficients for propellers of other projected area ratios would, for any value of indicated thrust per square inch of projected area, lie on a straight line joining the two. This assumption he does not now consider satisfactory, and in this treatment of the propeller problem his methods are revised and improved to allow for correction at this point and others tending to increased flexibility in use. The article considers the whole problem of propeller design and gives eight plates of charts, with descriptions and derivations. Illustrated with drawings of several types of blade outlines and sections. 17,800 words.—*Journal of the American Society of Naval Engineers*, May.

Relative Possibilities of the Diesel Oil Engine, Geared Turbine and Suction Gas Engine, as Compared with the Reciprocating Engine for Marine Propulsion.—By E. L. Orde, the Hon. Chas. A. Parsons, K. C. B., F. R. S.; R. J. Walker and A. C. Holzapfel. Specifications of machinery for each of these several types have been carefully prepared for the same vessel in comparison with the usual steam plant for such a ship, consisting of three single-end Scotch boilers and a three-crank triple engine. The requirements submitted to all for their comparative estimates were as follows: Length over all 412 feet, length between perpendiculars 400 feet, extreme beam 52 feet, molded depth 29 feet, draft 26 feet 1 inch, deadweight 8,465 tons, displacement 11,560 tons, speed $10\frac{1}{2}$ knots and indicated horsepower 2,600. Mr. E. L. Orde gave the comparison between a Diesel oil installation and steam for this ship. His figures are in three tables of expenses for the two types and a plot showing fuel costs for each ship at varying price per ton. Whatever variations actual practice might make from his assumptions would not affect the results, as the same figures were used for both. The Hon. Sir Chas. A. Parsons gave the comparison of a steam engine with geared turbines, submitting data from the results of trials and actual service from the *Vespasian*. On trial the geared turbines showed a steam economy of 15 percent, and after two years of constant service the mechanical features of the design are entirely satisfactory. Mr. A. C. Holzapfel makes the comparison for the suction gas motor. One point taken up extensively was the manner of caring for auxiliaries. These are to be operated by electricity. The main engines operate twin screws. Interesting data from his experimental vessel, *Holzapfel I.*, were presented, with plates showing relative spaces occupied by machinery of each type. 13,200 words.—*Transactions N. E. Coast Institution of Engineers and Shipbuilders*, April.

Panama Canal Tolls.—By Rear-Admiral Chas. H. Stockton, U. S. N. A brief review of this timely subject from the standpoint of international law. The provisions of the Clayton-Bulwer and Hay-Pauncefote treaties are stated and the policy generally agreed upon in such cases among the nations. The interpretation placed upon the discrimination clause admits the justice of granting free tolls to vessels trading from one coast to the other, but questions the propriety of doing so on the grounds of the total removal of such ships in time of war, with the consequent damage to the trade. This traffic, it is claimed, should be open to vessels of all nations. Only in this way can the monopoly of traffic by railroad-owned or operated ships be averted. The policy of free ships for this trade is also urged. 1,800 words.—*United States Naval Institute Proceedings*, June.

Propulsive Machinery and Oil Fuel in the United States Naval Service.—Capt. C. W. Dyson, U. S. N. A study of recent improvements in naval machinery design, particularly with regard to the use of turbines or reciprocating engines, and the introduction of oil for fuel. The latest reciprocating engines have increased the number of expansions, adopted straight ports and the resulting smaller clearances, forced lubrication system, the use of superheated steam and increased vacuum. The practical results have been an increased steam economy, as shown by a comparison of the engines of the *Delaware* and those of as recent a ship as the *Birmingham*, where the difference was 22.66 percent at full power in favor of the former. As to the weight of the machinery installation, the reciprocating engine is favored, as in the instance of the *Delaware*, with 773 tons, and *North Dakota*, whose turbine installation weighs 783 tons. The losses in turbines at cruising speed are well known, except in the cases where cruising turbines are used. The boiler plant required has been found to be more for the turbine battleship referred to. The comparison is fully carried out in detail and shows the reasons for installing reciprocating engines in the two latest battleships. Some valuable and very interesting figures are given, which will not be overlooked by designers. In speaking of the adoption and use of oil fuel in the navy, Capt. Dyson describes briefly the system in use and gives tables of results from evaporative tests on several torpedo-boat destroyers. By adopting oil as fuel on the battleships *Nevada* and *Oklahoma*, the fire room weights have been decreased over 25 percent, the fire room force halved, while the length of ship required for boilers has been decreased from 128 feet to 66 feet. 9,600 words.—*Journal of the American Society of Naval Engineers*, May.

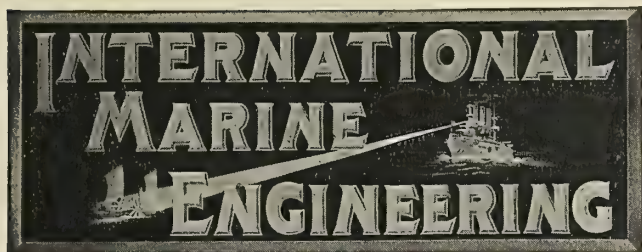
An Improvement in Floating Dry Docks.—By Civil Engineer A. C. Cunningham, U. S. N. The ordinary form of floating dry dock has the disadvantages of poor efficiency in self-docking, necessity of self-docking for complete painting and limitation as to size of ships possible to be carried. The design shown here is a combination of the principles of the Rennie pontoon dock and the Cunningham sectional dock, in which the sections are integrally connected together above the waterline. Outline sketches show how one section may be docked at a time with minimum of maneuvering and lifting power. By providing one extra section, the cleaning can go on continually, each taking its turn as spare and insuring good state of preservation of the whole structure. The design has the advantage of possible longitudinal expansion to suit the vessel lifted by adding more pontoons to the ends. When it is desired to increase lifting capacity without increasing length, deeper or wider pontoons may be used. With units of any size there is always the possibility of rising each pontoon separately in lifting smaller vessels. 1,500 words.—*United States Naval Institute Proceedings*, June.

The Enlargement of the Kaiser Wilhelm Canal.—A modern engineering work of more than usual size and of large commercial importance is the enlargement of the Kaiser Wilhelm Canal now nearing completion. Opened for the first time in 1895, the demands of traffic urged its enlargement a little more than ten years later. The improvements being carried on are on a large scale, a few general dimensions being, bottom width 144 feet instead of 72 as formerly, water level width of 335 feet instead of 216, depth 36 feet and a canal profile of 825 square meters (8,880 square feet) instead of 413 square meters. Curves will be straightened out, the least radius being 1,800 meters and most of them 3,000 meters. The locks at the entrances are being replaced by the biggest locks in existence, surpassing even those on the Panama Canal. These will have a useful length of 1,083 feet, width 147.6 feet, depth 45.25 feet. Each lock will be fitted with three sliding gates, each

weighing 1,000 tons. The labor problem is an interesting feature. Seven thousand six hundred laborers were employed last summer, as many as possible being Germans. Barracks are provided as quarters for all single men, and everything possible is done to suppress indulgence in alcoholic drinks without absolutely prohibiting them. Sunday and overtime work is allowed only in exceptional cases. Every laborer is medically examined and remains under medical control. The whole work, including dredging, building locks and rebuilding railroad bridges over the canal, is being carried on without interruption to traffic. A sum of approximately fifty-five million dollars (£11,300,000) was granted in 1907 and the work is to be completed by 1915. 5,600 words.—*Engineering*, June 21.

Messrs. Workman, Clark & Co.'s Works at Belfast.—Preparatory to the coming visit of the Institute of Mechanical Engineers to Belfast, the plant of Workman, Clark & Co. is the subject of a lengthy detailed description in a recent number of *Engineering*. Not only are the mechanical features of the place described, but the history of the yard's development is sketched. Begun in 1880, with four acres of ground on the north side of River Lagan to the east of Belfast Harbor, it has steadily progressed in size and equipment until at the present time it has in its 82½ acres of land two complete shipbuilding yards and an engineering works, which are capable of turning out ships up to 1,000 feet in length and machinery of the latest designs to correspond. The North Yard, so called from its location with respect to the River Lagan, has seven shipbuilding berths, two of which, added in 1910, are easily capable of taking ships of the largest dimensions now building. In the South Yards are berths for five ships up to 523 feet long. The two yards have separate organizations and a friendly rivalry exists between the two, which is productive of a desirable efficiency in production. The engineering works of the company are opposite the South Yard in Queens Road. Besides a large and complete boiler shop and machine shops, this contains the power plant for itself and the South Yard, smith shop, separate drawing and time offices, stores and dining room for the men. The descriptions of all are complete, giving in detail the account of any machine of unusual size or purpose, the method of drive, features of power supply, material handling, etc. The company's increasing prosperity, in spite of the fact that the materials of shipbuilding are not native to Ireland and the scarcity of skilled labor, is evidence of enterprise, continuous attention and ability in conducting the works in an efficient and economical manner. The article is well illustrated with photographs and drawings showing the locations and plans of the works. 12,500 words.—*Engineering*, July 19.

Inspection Duty at Navy Yards.—By Lieut.-Commander T. D. Parker, U. S. N., Honorable Mention, U. S. Naval Institute Prize Essay Contest, 1912. An essay on the subject of organized inspection departments for navy yards and shipbuilding plants doing naval work. The general question of what inspection is and what it should be, its difficulties and how they may be best met with present facilities, is first taken up. Specific suggestions are then made for the building up of a small organization for the broad field of all necessary inspection of this kind of work, and details worked out complete, including the duties of each member of the staff. Practical examples are given and the field of naval inspection is made clearer, the aims more definite and the methods easy of adoption. Written by a naval officer, for an audience in the naval service, it is, of course, for this need primarily, but the suggestions offered are by no means applicable in the navy alone, and the resourceful manager may easily find useful points to pick up. 10,800 words.—*United States Naval Institute Proceedings*, June.



Published Monthly at
17 Battery Place New York

By ALDRICH PUBLISHING COMPANY, INC.

H. L. ALDRICH, President and Treasurer

Assoc. Member of Council, Soc. N. A. and M. E.

and at

Christopher St., Finsbury Square, London, E. C.

E. J. P. BENN, Director and Publisher

Assoc. I. N. A.

H. H. BROWN, Editor

Member Soc. N. A. and M. E.; Assoc. I. N. A.

AMERICAN REPRESENTATIVES
GEORGE SLATE, Vice-President
E. L. SUMNER, Secretary

Circulation Manager, H. N. DINSMORE, 37 West Tremlett St., Boston
Mass.

Branch Office: Boston, 643 Old South Building, S. I. CARPENTER.

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The favorable condition of shipbuilding in the United States during the fiscal year is shown by the returns filed with the Bureau of Navigation, where it was reported that on July 1, 1912, one hundred and twenty steel vessels, aggregating 254,000 gross tons, were under construction, or under contract to be built, as against less than 100,000 gross tons at the same time a year ago. This means an increase of tonnage for the year of over 154 percent, and while the volume of tonnage reported is not large when compared with the tonnage under construction in Great Britain, where all previous records are being surpassed, yet when compared with the capacity of the American shipyards it is evident that the American shipbuilders will be more busily employed for several years to come than in the past decade. The situation in the American shipyards on the Atlantic coast is more clearly emphasized by the fact that, when in September sixteen yards were invited to bid on a steel hull designed by a prominent naval architect for early delivery, only five of the sixteen were interested enough to ask to see the specifica-

tions, the remaining eleven reporting that they are too busy with work in hand to consider taking on anything more at present for early delivery. The tonnage building on the Great Lakes shows a decrease of about 10,000 tons, as compared with a year ago, and part of the current year's construction is designed for salt water use. In this increase of shipbuilding the influence of the coming opening of the Panama Canal is manifest, as upwards of 80,000 tons are building for use through the canal. Preparations for the use of oil for fuel instead of coal are also evident in the shipbuilding returns, for seventeen tank steamers, ranging from 2,200 tons to 6,500 tons, are now under construction.

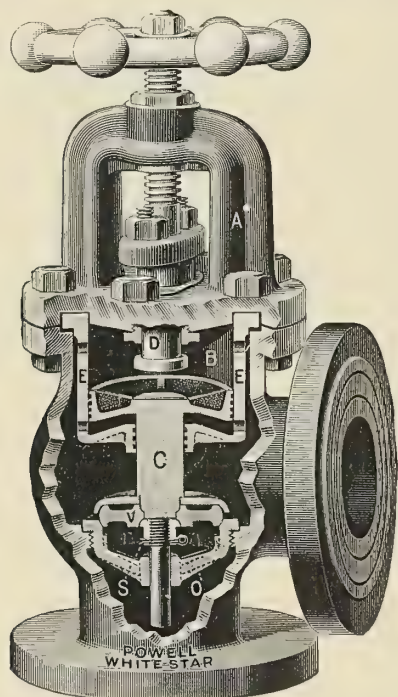
Elsewhere in this issue will be found those sections of the Panama Canal Act which relate directly to marine affairs. A careful perusal of these sections shows that in almost every case the limitations of the Act are clearly defined, except that in Section 5 one of the provisions, which in all probability will have a most important effect upon the shipbuilding industry, is placed in the hands of the Secretary of the Treasury for its final interpretation. This provision specifies that all materials of foreign production which may be necessary for the construction or repair of vessels built in the United States, and all such materials necessary for the building or repair of their machinery, and all articles necessary for their outfit and equipment, may be imported into the United States free of duty under such regulations as the Secretary of the Treasury may prescribe. At present the customs division of the Treasury Department is engaged in formulating these regulations, and it is not probable that they will be issued before the middle or the latter part of October. Until that time all importations coming under this head will be admitted under an arrangement whereby the question of the duty to be paid, if any, will be held in abeyance until the regulations are issued. It is evident that a literal interpretation of this provision will result in one of the most sweeping free trade enactments that the United States has ever experienced, since everything that goes into an American ship, including material, machinery and equipment, can be imported free of duty. The important question to be settled, then, and the one that will have an immediate effect upon both American and foreign manufacturers, is whether the Act means that all materials, supplies and equipment for shipbuilding shall be admitted free of duty; or, if not, where shall the line be drawn? We understand that the Treasury Department is seeking all the information that can be secured from interested sources before completing these regulations, so that anyone whose interests will be affected in any way by this law should make known at once to the Treasury Department his views on this question.

Improved Engineering Specialties for the Marine Field

The Powell "White Star" Automatic Non-Return Boiler Valve

In steam plants where more than one boiler is in use the value of a non-return boiler valve cannot be reckoned too highly if it eliminates, as it is claimed to do, the possibility of steam escaping into a boiler which might be unexpectedly out of commission or closed off for repairs. A feature in the operation of such a valve is the prevention of danger to workmen when engaged inside a boiler for cleaning or the insertion of new tubes.

In the Powell "White Star" automatic non-return boiler valve illustrated herewith it is claimed the latest boiler laws have been carefully met; the outside screw stem and yoke top



being one of the particular specifications; all parts throughout are of extra heavy pattern and good for working steam pressures up to 250 pounds. They are made either screwed or flanged ends.

The body and yoke are cast of a close-grained iron of high tensile strength. They are connected together by steel bolts and nuts of sufficient number to firmly bind the flanged faces together. The sheet packing is housed in a recess in the body neck flange under the projecting top of the dash-pot, and is held firmly in place by the compression given by the bolts and nuts when assembled.

The disk plunger *C* (to which is attached the disk holder *R*) works in the dash-pot *E*, and they are cast of steam bronze composition. The opening in the dash-pot *E*, through which the stem of plunger *C* is guided, also the rim of the upper part of the disk plunger, are grooved, so that these parts may work with a minimum of friction, and respond readily to any variation in the pressure. The dash-pot has four vent holes at top and bottom to allow the draining of any condensed water that may collect therein. The lift of the disk is equal to the depth of the dash-pot, insuring a full opening. The height of the lift is regulated as desired by raising or lowering the screw stem *D*.

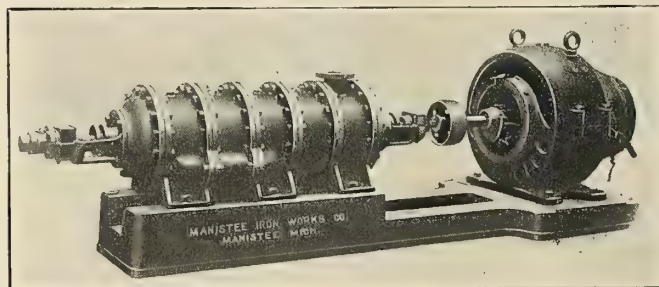
The disk and seat are made of white "Powelium" bronze. The disk is regrindable, reversible and renewable, and is

secured in the disk holder by nut *S*, which is locked in place by a cotter pin, and cannot possibly unscrew and drop off. The seat is renewable, and is cast with a guide for the lower part of the disk plunger stem, holding same perpendicular to the seat at all times. The expansion of the seat and body is uniform, the composition of the seat being made with that in view. Whenever necessary to do so the seat can be readily renewed by inserting a flat tool between the lugs projecting from the inner circle and unscrewing same.

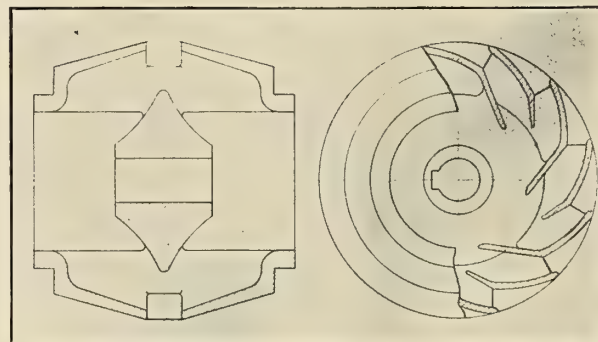
These valves are made by The William Powell Company, of Cincinnati, Ohio.

Rees Roturbo Pump

The Manistee Iron Works Company, Manistee, Mich., which is the American licensee of the Rees Roturbo Development Syndicate, Ltd., of Wolverhampton, is manufacturing the Rees Roturbo patent pressure chamber centrifugal pump. The characteristic feature of this type of pump is that it is a true turbine pump, the rotor having a strong turbine effect. This turbine effect is secured by making the impeller of large capacity for storing water, which is maintained by rotation



REES ROTURBO FEED PUMP



SECTION OF IMPELLER

at a constant maximum internal pressure independent of the external head, and by an ingenious application of the Venturi law transforming and extracting this pressure with a minimum amount of loss. Consequently, instead of throwing away the surplus speed energy of the water discharged when the head of delivery is reduced, the energy is extracted from the water before it leaves the pump casing. It is claimed that in this way all cavitation troubles are done away with, due to the internal pressure, and as there are no delicate vanes in the impeller there is no risk of breakage at this point. In a pump constructed in this way it is claimed that the power absorbed when running at a constant speed remains practically constant for all heads of discharge, and never appreciably ex-

ceeds that required for the head for which the pump is designed. Thus it is claimed that the pump is practically self-regulating in the highest degree, as it is impossible for any variation of head to throw an excessive strain on the driving motor. Whereas an ordinary centrifugal pump is limited to the designed capacity or head for operation at the best efficiency, since if the head or the volume of water vary it is necessary to change the speed of the pump or energy is lost, on the other hand, the Roturbo pump is designed so that it will automatically and hydraulically regulate the power absorbed under varying conditions.

The illustrations show the latest type of the Rees Roturbo boiler feed pump, direct coupled to an enclosed, ventilated, direct-current motor. The pump impeller consists of a series of pressure chambers, which are mounted upon a central shaft supported upon bearings throughout the whole length except that portion passing through the chambers. The whole pump is claimed to be in perfect hydraulic balance. The feed pump on test delivered 18,000 gallons per hour against a boiler pressure of 220 pounds per square inch, and required 50 horsepower for operation, showing a pump efficiency of 76.5 percent.

Sprague Electric Grab-Bucket Cranes

The problem of unloading bulk cargo freighters usually requires an apparatus that will not only remove the cargo from the hold of a vessel but also deposit it at a convenient place either on the pier or on shore. To meet these requirements the Sprague Electric Works, New York, has placed on the market a grab-bucket power crane which, it is claimed,



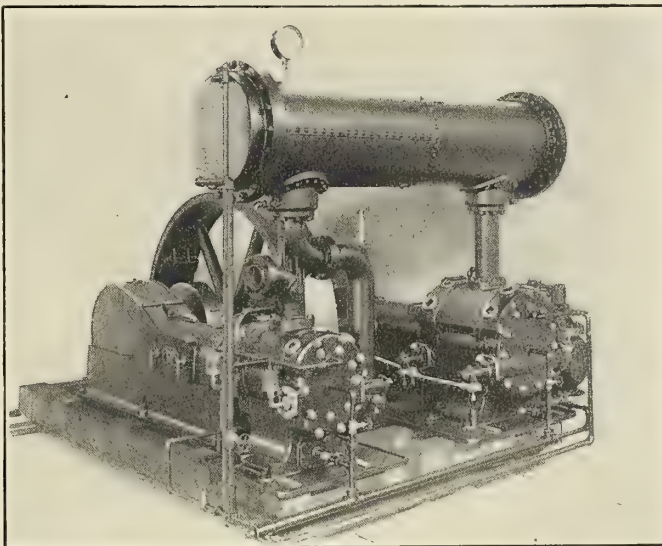
can shovel, lift, convey, deposit and pile bulk material without aid from any outside source. The apparatus consists of a clam-shell bucket which is operative by electrical means, and which conveys the loaded bucket along an I-beam runway, which can be supported on an independent structure or some existing structure as the case may be. A frame built of structural steel and steel castings contains the hoisting drum, motor, gears, etc., and is suspended from two trucks which support and carry the entire mechanism. The bucket is operated by three ropes which are anchored to two drums. A special sys-

tem of controlling the apparatus is provided by which the operator, whose position is on the crane itself, can, with a single controller, perform all the operations necessary in proper sequence for lifting, conveying and depositing bulk cargo.

A New Air Compressor

The Chicago Pneumatic Tool Company, Chicago, has placed on the market a new enclosed, self-oiling, belt-driven air compressor, known as Class M-CB, which has two-stage air cylinders, 16 inches and 10 inches in diameter and 12 inches stroke. At its rated speed of 210 revolutions per minute it has a displacement of 576 cubic feet per minute.

Mechanical inlet air valves of the semi-rotary Corliss type are used, actuated by eccentrics on the compressor shaft. The



discharge valves are of the company's air-cushioned poppet type, placed radially in the heads. This combination, it is claimed, insures high volumetric efficiency and the elimination of valve troubles, as the valves are interchangeable and accessible for adjustment and renewal.

The heads and cylinder walls are completely water-jacketed and arranged with independent water supply, permitting the use of solid gaskets between heads and cylinders. The frames are full tangye type with bored crosshead guides completely enclosing the crosshead bearings. The cranks and eccentrics are enclosed with substantial planished iron casing, enabling complete flood lubrication of the main bearings, crosshead and moving parts by means of automatic gravity lubrication. Inlet valves and pistons are lubricated by large glass sight-feed lubricators on the caps of inlet valves, and all valve gear bearings have extra large compression grease cups.

The inter-cooler is of the steel shell marine condenser type, mounted overhead, provided with composition tubes, baffle plates and separator drip pockets. The air cylinders are bolted directly to the tangye frames, and in addition extend down to large sole plates with drip guards all around.

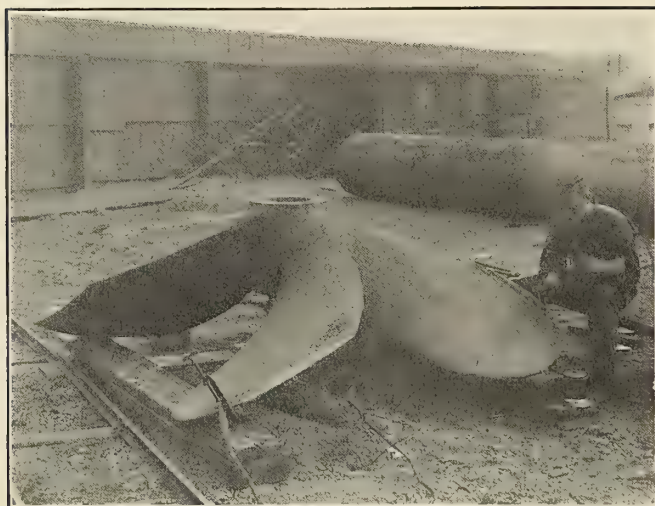
The cranks are of the balanced disk type pressed and keyed to shaft. The driving pulley is split-keyed to shaft and machine-true on face and edges. It is of unusually heavy design to give the necessary fly-wheel effect.

Control is effected by an improved throttling in-take controller operated by receiver pressure, capable of close regulation and adjusting the load to meet the air demands, so that the power consumption is reduced to a minimum.

The same type of machine is furnished in capacities up to 4,000 cubic feet per minute. Equivalent sizes and capacities can be furnished in short belt drive and motor drive with motor mounted directly on compressor shaft.

Electric Arc Welding in Ship Repairs

A successful electric arc welding plant consists essentially of a generator designed to maintain constant electromotive force under a fluctuating load; a special rheostat, either manually or automatically controlled, depending upon the operating conditions; a welding clamp of copper or iron and an assortment of welding pencils. These pencils are secret alloys, the composition and dimensions being chosen for each class of work. With these pencils are supplied special refractory fluxes which are applied by the user in accordance with directions, and these fluxes form the most essential part of the welding process, as upon them depend the quality of work and the speed of operation. An apparatus of this sort, which has



been used successfully in marine repair work, has been placed on the market by the Electric Welding Company, Produce Exchange Annex, New York. An example of the utility of this welding apparatus is shown in the illustration, where the broken tips of the propeller blades are being restored. Propellers have offered one of the most difficult problems to the arc welder, because, in the first place, it is difficult to weld cast iron, and then each grade of cast iron requires special treatment. Besides renewing broken blades by welding on new tips, holes or pitted surfaces can be filled and smoothed up to the true profile by depositing metal either with a carbon or metal pencil. In repairing tips, new tips are cast, the edge to be welded beveled off from both sides and welded. Tips weighing as much as 500 pounds have been successfully welded, and it is claimed that there is no limit to the size that can be handled. The Electric Welding Company above mentioned has welded propellers up to 20 feet in diameter. The repairing of marine boilers is also one of the most highly developed uses of arc welding. Usually cracks develop along the calking edges and extend toward the rivets and between them. Such cracks can be taken care of easily by arc welding, or, better still, if the furnace flange, wrapper sheet and the tube sheet are welded up and wasted parts filled with new metal such cracks can be prevented.

Demonstration of a Patent Submersible Pump

An interesting demonstration was recently conducted at Messrs. Gwynnes, where a flooded barge was pumped out by a small submersible motor pump, manufactured by Submersible & J-L Motors, Ltd., Southall, Middlesex. The carrying capacity of the barge was 100 tons, and when fully flooded the amount to be pumped out was considerably above this, or approximately 125 tons. The motor pump consisted of a 10-horsepower submersible electric motor combined in one

casing, with a 5-inch centrifugal Gwynne pump, running at 95 revolutions per minute off a 220-volt circuit, delivering 600 gallons per minute. The pump was suitable for operating at any head up to 35 feet. The barge had been previously submerged, and when the tide fell so that the gunwales began to show above water the pump was put in operation, and after pumping for about thirty minutes the barge was practically emptied. In this electric motor the water circulated freely through the interior and the bearings, which are adapted for water lubrication.

The control of the motor pump can be operated from a distance by the switch, and the pump started and stopped above or below water as required. In marine work motor pumps situated below the waterline could be operated from the upper deck of the ship. It is recommended that an oil engine generating plant be used for supplying the electric current, which would be quite independent of the boilers, and placed on an upper deck; thereby the risk of water interfering with the operation of the electric plant would be overcome.

Technical Publications

Electrical Propulsion of Ships. By H. M. Hobart. Size, 5½ by 8½ inches. Pages, 162. Illustrations, 43. New York, 1911: Harper & Bros. Price, \$2 net.

This book, which was published first in England by Harper & Bros., was reviewed on page 85 of our February, 1912, issue.

Ship Wiring and Fitting. By T. M. Johnson. Size, 4¼ by 6½ inches. Pages, 80. Illustrations, 47. New York, 1911: D. Van Nostrand Company. Price, 75 cents net.

Although this book is a small one and deals with a subject about which a good deal could be written, yet it will be found very useful to a marine engineer who has had little experience with electrical machinery. Almost every modern vessel is equipped with an electrical power plant, and electricity is used for various power purposes, for lighting the ship and sometimes for heating. Such apparatus is, of course, designed and specified by electrical engineers when the vessel is built, but after the vessel is turned over to its owners the duty of maintaining the electrical machinery falls upon the engine room staff. For this reason some knowledge of the fitting and, particularly, of the wiring is necessary. No attempt has been made in this book to describe in detail the construction of electrical machinery, but the general types of dynamos, engines, motors, switchboards, etc., are given, and then the usual methods of wiring different types of vessels are described. Lamps, bells, telephones, fans and special apparatus are taken up in the closing chapters.

Elementary Internal Combustion Engines. By J. W. Kershaw. Size, 5¼ by 7½ inches. Pages, 174. Illustrations, 117. New York and London, 1912: Longmans, Green & Company. Price, American edition, 90 cents net; English edition, 2/6 net.

The contents of this book are principally of a descriptive character, in which various types of internal-combustion engines and their fittings are described. It was intended that the book should give an elementary account of the construction and working of internal-combustion engines and gas producers, and that it should serve as an introduction to more advanced works dealing with the subject from a theoretical standpoint. The book is thoroughly up to date, because the engines described are mainly manufactured products now being placed on the market. Almost every type of internal-combustion engine is described, including gas engines, oil engines, gasoline (petrol) engines and other combustion motors. Only one chapter is devoted exclusively to marine engines, where the advantages and disadvantages of heavy oil engines for marine work are discussed.

A B C of Hydrodynamics. By R. de Villamil. Size, 5½ by 8½ inches. Pages, 135. Illustrations, 48. London, 1912: E. & F. N. Spon, Ltd. Price, 6/- net.

The title of this book would lead one to expect an elementary treatise on the subject of hydrodynamics. A perusal of the first chapter, however, which deals with the confused state of the subject of resistance of liquids, discusses the works of Lord Rayleigh, Lord Kelvin, Dr. Fleming and Dr. Hele Shaw, which will readily be recognized as advanced treatises on the subject. To fully appreciate the author's discussion it is therefore essential that the reader should be somewhat familiar with the works from which he quotes. There are thirteen chapters in the book, which cover in general the subjects of the movement of liquids and the law of flow, the resistance of liquids, viscosity and fluid friction and the motion of water in the rear of a body exposed to a stream. Quotations and references are made freely from the works of such authorities as Newton, Lancaster, Lamb, Dubat, R. E. Froude, Langley, Helmholtz, Prof. Perry, Prof. Osborne Reynolds, Col. Beaufoy Stokes, J. Bourne and others. Each chapter is closed with a few paragraphs summarizing the contents of the chapter.

Applied Methods of Scientific Management. By Frederick A. Parkhurst, M. E. Size, 6 by 9 inches. Pages, 320. Illustrations, 46. Plates, 9. New York, 1912: John Wiley & Sons. Price, \$2 net. London: Chapman & Hall, Ltd. Price, 8/6 net.

Scientific management is a subject on which writers are apt to theorize and generalize regardless of the results obtained in practice. This tendency, however, has been avoided in this book, and the subject has been treated from the practical point of view as the result of the author's extensive experience along these lines. In the preface he states his belief in adapting all tools to meet each existing condition as found. He believes in developing an existing plant to its highest possible efficiency before making large outlays for extensive alterations or additions, and this same principle he applies to the placing, development and advancement of each individual member in the work's organization. The obligations of the employer and employee to each other are not overlooked. Their interests are mutual, and the principles involved tend toward the promotion of their combined progress and prosperity. He states that the human element is at once the most important factor and the greatest variable in the problem which the organizer has to solve, and this his success depends largely upon his ability to recognize and handle this phase of the proposition.

Through Holland on the "Vivette." By E. Keble Chatterton. Pages, 246. Illustrations, 60. London, W. C., 1912: Seeley Service & Company, Ltd. Price, 6/- net.

Mr. E. Keble Chatterton has again placed us under a debt for a very readable book on a cruise which he made in his yacht *Vivette* from Harwich to Dover, thence to Calais, along the Belgium coast to Flushing, Amsterdam, and back. The *Vivette* is a 4-ton cutter, 25 feet over all, and is best described as a small edition of the Bristol Channel pilot cutters, which are reckoned to be the finest seaboats of their size and rig to be found anywhere. To those of our readers who are familiar with the writings of Mr. Chatterton, we need only say that the present volume is on a par with his other works. He is a keen observer, and not the least entertaining sections are descriptive of the places and people seen when he has put ashore to replenish stores. To the yachtsman, of course, the book specially appeals, as it is written by a yachtsman of experience and a writer of ability. But the non-sailing man will find it almost as equally interesting for the entertaining descriptions of Dutch life with which it abounds. Mr. Chatterton had a keen artist for a companion, and the reproduction of Norman Carr's photographs and sketches add considerably to the value and interest of the book. The last half-

dozen pages are devoted to sailing directions for anyone who is anxious to carry out a sailing tour through Holland.

Hendricks' Commercial Register of the United States for Buyers and Sellers. Twenty-first edition. Size, 7½ by 10 inches. Pages, 1,574. New York, 1912: S. E. Hendricks Company. Price, \$10.

The twenty-first annual revised edition of "Hendricks' Commercial Register of the United States for Buyers and Sellers" has just been issued. Established in 1891, it has been published annually since that time. Its aim is to furnish complete classified lists of manufacturers for the benefit of those who want to buy as well as for those who have something to sell. It covers very completely the architectural, engineering, electrical, mechanical, railroad, mining, manufacturing and kindred trades and professions. The present is by far the most complete edition of this work so far published. The twentieth edition required 108 pages to index its contents, while the twenty-first edition requires 122 pages, or fourteen additional pages. As there are upwards of 400 classifications on each page, the fourteen additional pages represent the manufacturers of over 5,000 articles, none of which have appeared in any previous edition. The total number of classifications in the book is over 50,000, each representing the manufacturers or dealers of some machine, tool, specialty or material required in the architectural, engineering, mechanical, electrical, railroad, mine and kindred industries. The twentieth edition numbered 1,419 pages, while the twenty-first edition numbers 1,574, or 155 additional pages. An important feature of this commercial register is the simplicity of its classifications. They are so arranged that the book can be used for either purchasing or mailing purposes. The book also gives much information following the names of thousands of firms that is of great assistance to the buyer, and saves the expense of writing to a number of firms for the particular article required. The trade names of all articles classified are included as far as they can be secured.

Obituary

MR. JOHN HAUG, consulting engineer and naval architect, died Sept. 9 at his home in San Francisco, Cal. Mr. Haug, who had many friends in marine circles all over the world, was a native of Germany, and there acquired his first experience in engineering work. He was then associated, in England, with the late Mr. J. Macfarlane Gray, afterwards coming to the United States, where he entered into partnership with Mr. Archbold, who had been chief engineer of Commodore Perry's expedition to Japan in 1852. Mr. Haug was ship and engineer surveyor to Lloyd's at Philadelphia from 1880 to 1900, when he resigned to devote his time to consulting work. He designed ships and machinery and superintended construction for the Philadelphia & Reading Railway Company, the Red D Line, the New York & Porto Rico Steamship Company, the Chesapeake Steamship Company and the Standard Oil Company. He was a pioneer in the introduction of bulk oil vessels, and later in the application of internal-combustion engines to their propulsion, designing and building the first successful internal-combustion tankers in the United States while engineer-in-chief of the marine department of the Standard Oil Company, of California.

A total of 224 vessels, aggregating over a million tons, have been built, or are now under construction, according to the Isherwood system of longitudinal framing. Of this shipping 392,000 tons are oil-tank vessels, which represent about 76 percent of the total tonnage of oil steamers now building throughout the world. In the United States, where seventeen oil-tank vessels are now under construction, twelve of them are being built to the Isherwood system.

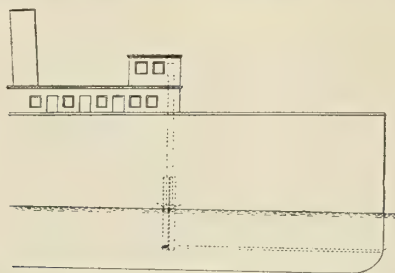
Selected Marine Patents

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

1,020,980. SHIP-SPEED INDICATOR. LEWIN J. HEATHCOTE OF BALTIMORE, MARYLAND.

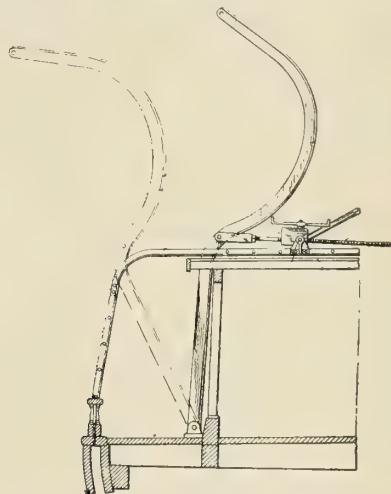
Claim 2.—In a ship speed indicator the combination with a receptacle having a water inlet near its bottom and below the water line, of a float in said receptacle; a pipe extending from the said inlet to the exterior of the ship below the water line; an indicator device; means for sup-



porting said indicator device; connections between the float and indicator device and means for adjustably securing the indicator device with respect to its support and also with respect to the float. Seven claims.

1,021,545. SHIP'S DAVIT AND MEANS FOR OPERATING THE SAME. WILLIAM L. MESSICK, OF IRVINGTON, VIRGINIA.

Claim 1.—In combination with the deck of a vessel and a davit pivoted thereto, an elevated structure composed of separated bars which extend transversely of the deck, between which bars the davit is adapted for



vibration, a trunnioned block supported by the elevated bars, an interiorly threaded sleeve adapted for rotation within the block by means of gearing, and a threaded bar which extends through the interiorly threaded sleeve and is pivoted to the davit. One claim.

1,023,843. BILGE-DISCHARGING DEVICE. JOHN J. HALL, OF BUCKSPORT, ME.

Claim 1.—A bilge-discharging device consisting of a tubular outlet member adapted to be secured to a ship hull, a valve casing threaded on said member and provided with an inclined valve seat, a check valve pivoted in said casing to engage said valve seat and adapted to occupy when in a closing position an inclined relation to said valve casing and adapted to open outwardly of said valve seat, a cap threaded on said valve casing above said valve, a second valve casing threaded on the first valve casing and provided with downwardly converging valve seat guides, a valve V-shape in cross section movable between the valve seat guides and means for forcing the last valve in closing position. One claim.

1,024,477. SHIP CONSTRUCTION. JOSEPH R. OLDHAM, OF CLEVELAND, OHIO.

Claim 1.—In a ship or vessel having water ballast chambers and anti-rolling tanks along the upper wings of holds, a plurality of transverse girders, beneath the decks, constructed with a large hollow, lower flange, joining and supporting the anti-rolling tanks and water ballast chambers, and forming a strong and watertight conduit or channel adapted for the conveyance of free water between said anti-rolling tanks. Ten claims.

1,024,682. CONSTRUCTION OF BOATS AND SHIPS. WILLIAM HENRY FAUBER, OF NANTERRE, FRANCE.

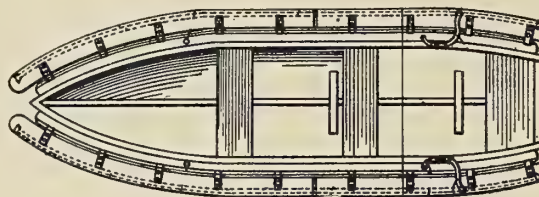
Claim 1.—A hydroplane boat provided with a plurality of hydroplanes arranged in stepped relation and forming the flotation surface of its bottom, at least one of said hydroplanes consisting of two hydroplane members arranged at opposite sides of the center line of the bottom and inclined laterally and downwardly toward said center line; said hydro-

plane members having their angle of rearward inclination at said center line less than their angle of rearward inclination at their outward lateral margins. Twenty-nine claims.

British patents compiled by G. E. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton Building, W. C., London.

3,808. ATTACHMENTS FOR LIFE BOATS. A. E. WICKMAN, WILLMAR, MINN.

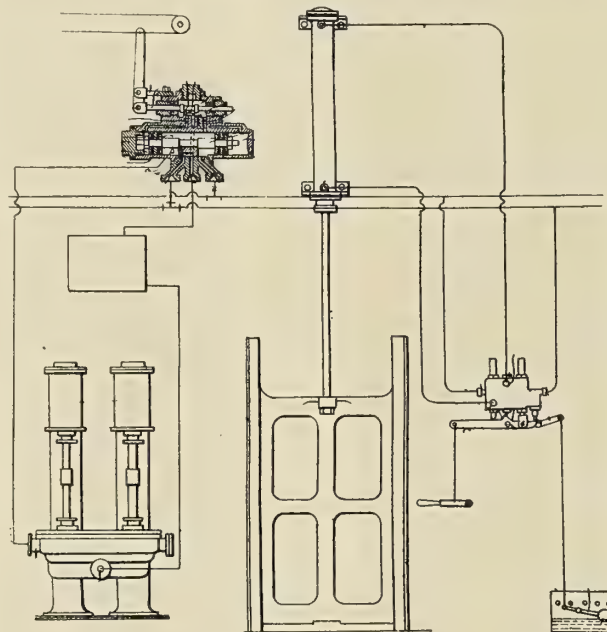
Tubular tanks extend along the sides of the boat, and each contains oil and compressed air separated by a flexible diaphragm. A pipe leads from the oil compartment to a distributing pipe, also running length-



wise of the boat, and can be opened from the boat to allow the air to force out oil for calming the sea. The oil and air container also serves as a buoyancy outrigger.

13,415. FLUID-PRESSURE APPARATUS FOR OPERATING BULKHEAD AND OTHER DOORS. F. J. PIKE, BECKENHAM, AND H. NEVILLE, FOREST HILL.

By this invention a two-way reversing valve is used at each door between the mains and the door cylinder, and is kept in its normal position, in which the doors can be opened or closed from the bridge in such a way that, when operated locally to reverse the bridge control, it returns to normal when locally released. For closing one or more doors by the rising of a float in the bilge, each door valve has a plunger normally subjected to pressure to reverse the door valve subject to the control of a trigger operated by the bilge float. To reverse the door



valve the plunger may, for example, be subjected to pressure in the main under pressure when the doors are opened from the bridge or to spring pressure for the same purpose, and also to fluid pressure in the other, or closing main, in which case the fluid pressure counteracts the spring. To provide that a door when partially or quite closed may be held against simultaneous opening from the bridge a non-return valve is located, and when closed it either prevents exhaust from the closing end of the door cylinder or cuts off connection with the opening end of it. This valve is normally held open, and is closed to eliminate opening from the bridge. Where the doors are not to open simultaneously from the bridge a non-return valve is located so that when closed it either prevents exhaust from the closing end of the door cylinder or cuts off connection with the opening end of it, and which is normally held closed by the flow to or from the cylinder, means being provided for opening the valve locally to open a closed door.

29,310. FLUID PRESSURE APPARATUS FOR OPERATING BULKHEAD AND OTHER DOORS. F. J. PIKE, BECKENHAM, AND H. NEVILLE, FOREST HILL.

Relates more particularly to controlling valves for a reversible two-main system, one main being subjected to pressure and the other opened to exhaust. These mains are alternatively connected to pressure and exhaust for simultaneously opening or closing a number of doors from a central station. The door controlling valve has a slide having a flat face and so fitted that the pressure fluid is active upon only a portion of the arena of the back of it, mechanical devices pressing it against its seat. The application of such valves to the system is described.